



TRICOR®

Coriolis Mass Flow Meter with TCE 8000 transmitter





Manual-Version

TCM_E80_CLASSIC_M_EN_190215_E006

SW-Version

This manual is valid for

Main SW: Mv3.40 and higher

Display SW: Dv3.40 and higher

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1. General Information

1.1. Features

The TRICOR CLASSIC product line meets general industrial requirements with out-of-the-box ease of use. Lower cost and lower performance specs meet broader application needs. Typically used in paint, coatings and dosing of non-corrosive fluid requiring 0.3 % accuracy and low to zero maintenance.

Features

- FlushableTCE 8000 transmitters with an easy-to-use interface
- Economically-priced, non-calibrated but with excellent repeatability
- Optional custom-calibrated meters with high performance specifications
- No moving parts
- Simultaneous measuring of mass flow, density and temperature
- Calculation of volume flow as well as mass and volume total
- Flushable

The TRICOR CLASSIC Mass Flow Meters are available as compact versions with onsite display and as meter with remote display for wall or panel mount.

All versions are available as standard version as well as Ex certified for hazardous locations (ATEX, IECEx, cCSAus).

The meters provide the following features:

- A graphic display
- Menu driven control with soft keys for easy operation (also without manual)
- Magnet hall switches for Ex areas
- Two freely programmable 4 ... 20 mA outputs
- One freely programmable frequency output
- One control input and one control output
- RS485 interface

Available options are:

- HART® interface
- One 4 ... 20 mA input for pressure measurement
- Pressure compensation
- Foundation Fieldbus® communications



Fig. 1: Compact versions

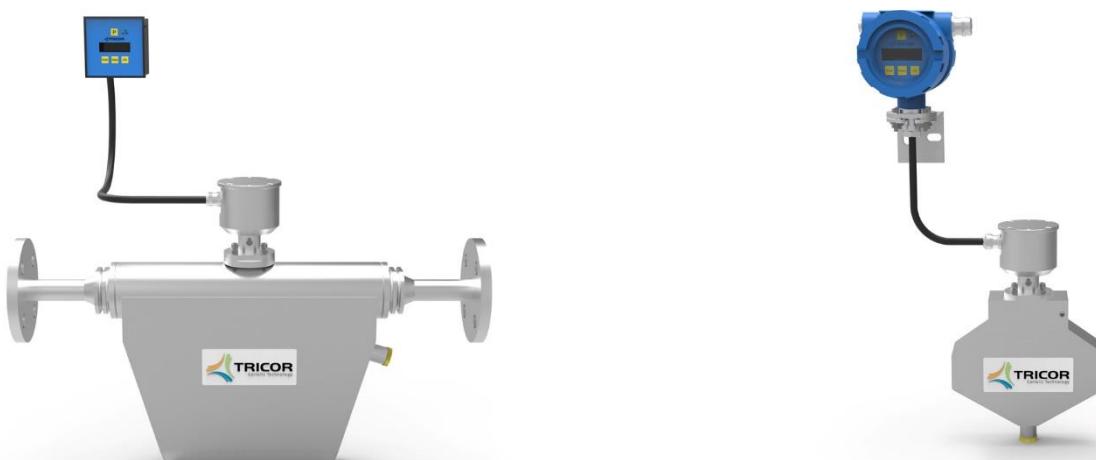


Fig. 2: Separate version with panel mount (left) or wall mount (right) transmitter



1.2. Safety

1.2.1. General Safety

All statements regarding safety of operation and technical data in this manual will only apply when the TRICOR CLASSIC Mass Flow Meter is operated correctly in accordance with this manual.

The data for Ingress Protection (IPxx) will only apply when all connectors are capped properly with the corresponding counterpart with the same or better IP rating. Cable glands must be populated with cables with the specified diameter and closed properly. The display cover must be closed.

During operation all openings of the housing must be closed unless otherwise is noted in this manual.

All electrical connections to the load and to the supply must be made with shielded cables unless otherwise is noted in this manual. The TCM must be grounded.

As a protection against fire in the positive supply, a fuse with a current rating not higher than the current carrying capacity of the cable used is required.

Before installing the Flow Meter and transmitter, the user is responsible to ensure that all wetted parts are compatible with the fluid or gas to be measured.

The user has to adhere to the instructions for installing electrical devices and corresponding instructions.

The devices described in this manual may only be connected and operated by authorized and qualified personnel.

1.2.2. Special Condition of Use for Ex Installations

Before installing and using TRICOR CLASSIC Mass Flow Meters in hazardous locations it is absolutely needed to read and to observe this Installation Manual and "Control drawing for hazardous areas".

In hazardous locations the enclosure lids of the transmitter must not be opened under any circumstances if the supply voltage is alive. For operating the keys the magnet must be used.

The analog and digital I/O signals are not specified for driving Ex i circuits.

When using long cables make sure that the maximum inductances and capacitances for the respective voltage or gas group are not exceeded.

WARNING!

All specified limiting values and parameters stated in "Control drawing for hazardous areas" must be adhered to at all times. Failure to do so can cause equipment failure and can lead to serious injury or death.

WARNING!

Potential risk of sparking from aluminum alloy enclosure due to impact and friction. This shall be considered during installation.

WARNING!

The equipment contains a shunt Zener diode interface, which requires connection to a suitable earth in accordance with IEC/EN 60079-14.

WARNING!

The installer shall ensure that the maximum ambient temperature of the equipment when installed is not exceeded.

WARNING!

Process temperature range is determined by temperature class for remote version TRICOR transmitter (see "Control drawing for hazardous areas").

1.2.3. Rupture Disc Handling

All TRICOR CLASSIC flow meters are fitted with a rupture disc installed on the case. A rupture disc, also known a "burst disc," is a pressure relief device to protect systems from over-pressurization. In a Coriolis flow meter, the rupture disc prevents pressure from building up inside the welded case. In the event of an extreme failure where the internal flow tubes leak, the rupture disc element will open up once the internal case pressure exceeds approximately 4 bar [58 psi].

To avoid personal injury or property damage, connect a pipe or hose to the rupture disc housing in order to direct the relieved liquid and/or gas from the meter's case through the rupture disc to a safe location, away from operators in the area. It is the user's sole responsibility for the design of adequate venting and installation of adequate vent piping or directional flow after rupture occurs with the rupture disc as intended.

Particles may discharge when the rupture disc ruptures. These particles may be part of the rupture disc itself, or other environmental matter in the system. It is the user's sole responsibility to ensure that the particles are directed to a safe location to prevent personal injury or property damage.

WARNING!

Take care not to puncture the rupture disc when installing a pipe or fitting to the rupture disc housing, which could cause premature failure of the rupture disc.

The flow meter case is filled with a dry inert gas to prevent moisture from building up. Any puncture or other physical damage to the rupture disc would allow moisture into the meter case, compromising the integrity of the meter and potentially resulting in inaccurate measurement results or total meter failure over time.

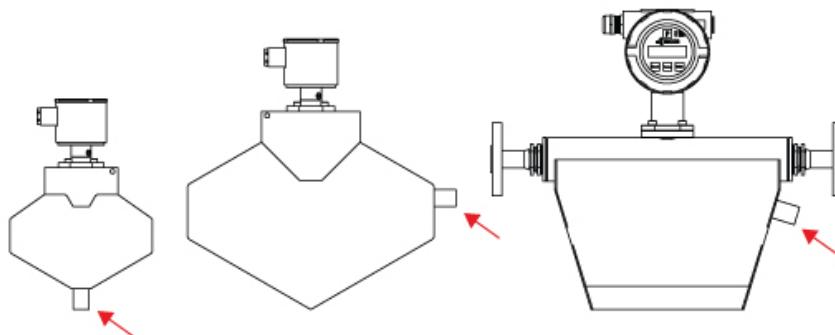


Fig. 3: Rupture disc locations vary by the meter size and style



Fig. 4: Warning sticker found near the rupture disc on all meters



1.2.4. Warnings in this Manual

NOTE:

Notes provide important information for the correct usage of the equipment. If the notes are not observed, a malfunction of the equipment is possible.

WARNING!

Warnings provide very important information for the correct usage of the equipment. Not observing the warnings may lead to danger for the equipment and to danger for health and life of the user

1.3. Ordering Codes and Accessories

1.3.1. Ordering Codes (other options available)

| TCE | | 8 | X | X | X | - | X | - | X | X | X | X | - | XX | - | XX |
|--|--|---|---|---|---|---|---|---|---|---|---|---|---|----|---|-------|
| Housing material: Aluminum | | 8 | 0 | | | | | | | | | | | | | |
| Housing material: stainless steel (316L) | | 8 | 1 | | | | | | | | | | | | | |
| Transmitter for TCM 0325 to TCM 7900 | | | | 0 | 1 | | | | | | | | | | | |
| Transmitter for TCM 028K to TCM 065K | | | | 1 | 1 | | | | | | | | | | | |
| Transmitter for TCM 230K | | | | 1 | 2 | | | | | | | | | | | |
| Housing | | | | | | | | | | | | | | | | |
| Wall mount (housing for $\frac{1}{2}$ " NPT cable glands) | | | | | | | | | | | | | | | | |
| Wall mount (housing for M20x1.5 cable glands) | | | | | | | | | | | | | | | | |
| Panel Mount ¹⁾ | | | | | | | | | | | | | | | | |
| Options | | | | | | | | | | | | | | | | |
| Interface²⁾ | | | | | | | | | | | | | | | | |
| RS485 (Modbus RTU) | | | | | | | | | | | | | | | | S |
| RS485 (Modbus RTU) + HART® | | | | | | | | | | | | | | | | A |
| Supply voltage | | | | | | | | | | | | | | | | |
| 24 V DC + 90 ... 264 V AC (only housing S) | | | | | | | | | | | | | | | | B |
| 24 V DC | | | | | | | | | | | | | | | | D |
| 90 ... 264 V AC (only housing W, I) | | | | | | | | | | | | | | | | M |
| Transmitter options | | | | | | | | | | | | | | | | |
| Standard | | | | | | | | | | | | | | | | S |
| Pressure compensation, 4 ... 20 mA input | | | | | | | | | | | | | | | | A |
| Cable length | | | | | | | | | | | | | | | | |
| 3 Meters [\approx 10 ft.], standard (high temperature) | | | | | | | | | | | | | | | | S (H) |
| 6 Meters [\approx 20 ft.]. (high temperature) | | | | | | | | | | | | | | | | B (I) |
| 10 Meters [\approx 33 ft.] (high temperature) | | | | | | | | | | | | | | | | C (J) |
| 15 Meters [\approx 49 ft.] (high temperature) | | | | | | | | | | | | | | | | D (O) |
| 20 Meters [\approx 65 ft.] (high temperature) | | | | | | | | | | | | | | | | E (P) |
| 3 Meters [\approx 10 ft.], offshore cable | | | | | | | | | | | | | | | | F |
| D-SUB Connector, (housing S), separate cable required | | | | | | | | | | | | | | | | N |
| EX-protection | | | | | | | | | | | | | | | | |
| ATEX + IECEx Zone1: Group IIC or IIB, T2...T4 | | | | | | | | | | | | | | | | Ex |
| ATEX Zone 2: II3G Ex nA IIC, T2...T4 Gc | | | | | | | | | | | | | | | | Exn |
| cCSAus: Class 1, Division 1: Group A, B, C, D or C, D, T2...T4 ³⁾ | | | | | | | | | | | | | | | | Ex1 |
| ATEX+IECEx, Zone 1: Group IIC or IIB, T2...T4 and | | | | | | | | | | | | | | | | Ex3 |
| cCSAus: Class 1, Div. 1: Group A, B, C, D or C, D, T2...T4 ³⁾ | | | | | | | | | | | | | | | | |
| EAC (TR-CU): Group IIC or IIB, T2 ... T4 ³⁾ | | | | | | | | | | | | | | | | ExR |
| Customer options | | | | | | | | | | | | | | | | |
| NOC (Net Oil Computer) | | | | | | | | | | | | | | | | 0 1 |

¹⁾ Only for TCE 80**.²⁾ Other interfaces on request.³⁾ For Ex1, Ex3, EAC (TR-CU) the transmitter is only available in aluminum housing.



| TCM | XXXX | XX | XX | XX | XX | XX | XX | Ex | XX |
|---|------|----|----|----|----|----|-----|-----|----|
| Process connections⁴⁾ | | | | | | | | | |
| see page 12 ff | | | | | | | | | |
| Mechanical options | | | | | | | | | |
| Medium Temperature range: | | | | | | | | | |
| -40 °C ... +100 °C [-40 °F ... +212 °F] | | | S | | | | | | |
| -40 °C ... +150 °C [-40 °F ... +302 °F] Ex _{max} : 135 °C [275 °F] | | | H | | | | | | |
| -40 °C ... +70 °C [-40 °F ... +158 °F], Ex, compact | | | E | | | | | | |
| -60 °C ... +200 °C [-76 °F ... +392 °F] | | | T | | | | | | |
| Pressure range | | | | | | | | | |
| With rupture disc max. 4 bar [58 psi] | | | G | | | | | | |
| Mechanical Design | | | | | | | | | |
| Standard | | | S | | | | | | |
| Face to face length | | | | | | | | | |
| Standard (other length on request) | | | S | | | | | | |
| Electronics options | | | | | | | | | |
| Electronics type | | | | | | | | | |
| Junction box 1.4404 [316L] | | | | H | Z | Z | S | | |
| Meter mount, die cast aluminum housing for 1/2" NPT cable glands ⁵⁾ | | | C | | | | | | |
| Meter mount, die cast aluminum housing for M20x1.5 cable glands ⁵⁾ | | | K | | | | | | |
| Meter mount, stainless steel housing for 1/2" NPT cable glands ⁵⁾ | | | M | | | | | | |
| Meter mount, stainless steel housing for M20x1.5 cable glands ⁵⁾ | | | O | | | | | | |
| Meter mount electronics TCE 6000 ⁶⁾ | | | F | | | | | | |
| Interface⁷⁾ | | | | | | | | | |
| RS485 (Modbus RTU) | | | | S | | | | | |
| RS485 (Modbus RTU) and HART® | | | | A | | | | | |
| RS485 (Modbus RTU) + FF (not with Ex) | | | B | | | | | | |
| FF (Foundation Fieldbus®) | | | D | | | | | | |
| RS485 (Modbus RTU) + USB (only TCE 6000) | | | F | | | | | | |
| Not used | | | Z | | | | | | |
| Supply voltage | | | | | | | | | |
| 24 V DC | | | | D | | | | | |
| 90 ... 264 V AC | | | | M | | | | | |
| Not used | | | | Z | | | | | |
| Options | | | | | | | | | |
| Pressure compensation, 4 ... 20 mA input | | | | | A | | | | |
| 8-pin I/O connector (TCE 6000 only) | | | | | B | | | | |
| Optical I/O (TCE 6000 only) | | | | | C | | | | |
| No option | | | | | S | | | | |
| EX-protection | | | | | | | | | |
| ATEX + IECEx Zone 1: Group IIC or IIB, T2...T4 | | | | | | | Ex | | |
| ATEX Zone 2: II 3G Ex nA IIC, T2...T4 Gc | | | | | | | Exn | | |
| cCSAus: Class 1, Division 1: Group A, B, C, D or C, D, T2...T4 ⁸⁾ | | | | | | | Ex1 | | |
| ATEX+IECEx: Zone 1: Group IIC or IIB, T2...T4 and cCSAus: Class 1, Division 1: Group A, B, C, D or C, D, T2...T4 ^{8,9)} | | | | | | | Ex3 | | |
| EAC (TR-CU): Group IIC or IIB, T2 ... T4 ⁸⁾ | | | | | | | ExR | | |
| Special Options | | | | | | | | | |
| NOC (Net Oil Computer) | | | | | | | | 0 1 | |

⁴⁾ For connections not indicated with installation length, please contact manufacturer.

⁵⁾ For TCM compact version with Ex-protection temperature class T4 only.

⁶⁾ Ex-protection only available in the option Exn. TCE 6000 transmitter is not applicable for TCM 230K.

⁷⁾ Other interfaces on request.

⁸⁾ For Ex1, Ex3, EAC (TR-CU) the transmitter is only available in aluminum housing.

⁹⁾ Only with remote transmitter.

1.3.2. Process Connections

1.3.2.1. Slip on, process connection dim. + facing acc. ANSI B16.5, Installation length in mm [inch]

| Process connection ¹⁰⁾ | Code | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K |
|-----------------------------------|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------|----------|
| ½" ANSI flange class 150 | AA | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| ½" ANSI flange class 300 | AB | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| ½" ANSI flange class 600 | AC | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| ½" ANSI flange class 900 | AD | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| ½" ANSI flange class 1500 | BV | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | | | | |
| ½" ANSI flange class 2500 | BE | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | | | | | |
| <hr/> | | | | | | | | | | |
| ¾" ANSI flange class 150 | BA | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| ¾" ANSI flange class 300 | BB | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| ¾" ANSI flange class 600 | BC | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| ¾" ANSI flange class 900 | BD | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| ¾" ANSI flange class 1500 | AI | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | | | | | |
| <hr/> | | | | | | | | | | |
| 1" ANSI flange class 150 | AE | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| 1" ANSI flange class 300 | AF | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| 1" ANSI flange class 600 | AG | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| 1" ANSI flange class 900 | AH | 390 [15.35] | 390 [15.35] | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| 1" ANSI flange class 1500 | AQ | 390 [15.35] | 390 [15.35] | | | 460 [18.11] | | | | |
| 1" ANSI flange class 2500 | BN | 390 [15.35] | 390 [15.35] | | | | | | | |
| <hr/> | | | | | | | | | | |
| 1½" ANSI flange class 150 | AJ | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| 1½" ANSI flange class 300 | AK | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| 1½" ANSI flange class 600 | AL | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| 1½" ANSI flange class 900 | AM | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| 1½" ANSI flange class 1500 | BI | | | | | 460 [18.11] | | | | |

¹⁰⁾ Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.



1.3.2.2. Slip on, process connection dim. + facing acc. ANSI B16.5, Installation length in mm [inch]

| Process connection ¹¹⁾ | Code | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K |
|-----------------------------------|------|----------|----------|----------|----------|----------|----------|----------------|----------------|----------------|
| 2" ANSI flange class 150 | AN | | | | | | | 625 [24.61] | 830 [32.68] | |
| 2" ANSI flange class 300 | AO | | | | | | | 625 [24.61] | 830 [32.68] | |
| 2" ANSI flange class 600 | AP | | | | | | | 625 [24.61] | 830 [32.68] | |
| 2" ANSI flange class 900 | AR | | | | | | | 625 [24.61] | 830 [32.68] | |
| 2" ANSI flange class 1500 | BU | | | | | | | | 830 [32.68] | |
| 2½" ANSI flange class 150 | BT | | | | | | | | 830 [32.68] | |
| 2½" ANSI flange class 300 | BY | | | | | | | | 830 [32.68] | |
| 2½" ANSI flange class 600 | BQ | | | | | | | | 830 [32.68] | |
| 2½" ANSI flange class 900 | BW | | | | | | | | 830 [32.68] | |
| 3" ANSI flange class 150 | AS | | | | | | | 625 [24.61] | 830 [32.68] | 915 [36.02] |
| 3" ANSI flange class 300 | AT | | | | | | | | 830 [32.68] | 915 [36.02] |
| 3" ANSI flange class 600 | AU | | | | | | | | 830 [32.68] | 915 [36.02] |
| 3" ANSI flange class 900 | AV | | | | | | | | 830 [32.68] | 915 [36.02] |
| 4" ANSI flange class 150 | AW | | | | | | | | 830 [32.68] | 915 [36.02] |
| 4" ANSI flange class 300 | AX | | | | | | | | 830 [32.68] | 915 [36.02] |
| 4" ANSI flange class 600 | AY | | | | | | | | 830 [32.68] | 915 [36.02] |
| 4" ANSI flange class 900 | AZ | | | | | | | | 830 [32.68] | 915 [36.02] |
| 5" ANSI flange class 150 | BF | | | | | | | | | 915 [36.02] |
| 5" ANSI flange class 300 | BG | | | | | | | | | 915 [36.02] |
| 5" ANSI flange class 600 | BH | | | | | | | | | 915 [36.02] |
| 5" ANSI flange class 900 | BJ | | | | | | | | | 915 [36.02] |
| 6" ANSI flange class 150 | BM | | | | | | | | | 915 [36.02] |
| 6" ANSI flange class 600 | BX | | | | | | | | | 915 [36.02] |

¹¹⁾ Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.2.3. Slip on, process connection dim. + facing acc. EN 1092-1 Form B,
Installation length in mm [inch]

| Process connection ¹²⁾ | Code | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K |
|---|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------|----------|
| DN 10, EN flange PN 40 | DS | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | | | | | |
| DN 10, EN flange PN 63 | DZ | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | | | | | |
| DN 10, EN flange PN 100 | EA | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | | | | | |
| DN 10, EN flange PN 160 | EB | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | | | | | |
| DN 10, EN flange PN 250 | EC | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | | | | | |
| DN 10, EN flange PN 400 | ED | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | | | | | |
| DN 15, EN flange PN 40 | DA | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| DN 15, EN flange PN 63 | EF | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| DN 15, EN flange PN 100 | DB | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | | | |
| DN 15, EN flange PN 160 | EG | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | | | | |
| DN 15, EN flange PN 250 | EH | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | | | | |
| DN 15, EN flange PN 400 | EI | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | | | | |
| DN 20, EN flange PN 40 | DT | | | | | 460 [18.11] | 460 [18.11] | | | |
| DN 25, EN flange PN 40 | DC | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| DN 25, EN flange PN 63 | EJ | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| DN 25, EN flange PN 100 | DD | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| DN 25, EN flange PN 160 | DW | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | | | | |
| DN 25, EN flange PN 160 Mat.: 2.4602 | DW | | | | | | | 625 [24.61] | | |
| DN 25, EN flange PN 250 | DP | 390 [15.35] | 390 [15.35] | 420 [16.54] | 420 [16.54] | 460 [18.11] | | | | |
| DN 25, EN flange PN 400 | DV | 390 [15.35] | 390 [15.35] | | | 460 [18.11] | | | | |
| DN 32, EN flange PN 40 | DR | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |

¹²⁾ Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.



1.3.2.4. Slip on, process connection dim. + facing acc. EN 1092-1 Form B,
Installation length in mm [inch]

| Process connection ¹³⁾ | Code | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K |
|-----------------------------------|------|----------|----------|----------|----------|----------------|----------------|----------------|----------------|----------------|
| DN 40, EN flange PN 40 | DE | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| DN 40, EN flange PN 63 | EK | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| DN 40, EN flange PN 100 | DF | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| DN 40, EN flange PN 160 | EL | | | | | 460 [18.11] | | | | |
| DN 40, EN flange PN 250 | EM | | | | | 460 [18.11] | | | | |
| DN 40, EN flange PN 400 | EN | | | | | 460 [18.11] | | | | |
| <hr/> | | | | | | | | | | |
| DN 50, EN flange PN 16 | EO | | | | | | | 625 [24.61] | 830 [32.68] | |
| DN 50, EN flange PN 40 | DG | | | | | | | 625 [24.61] | 830 [32.68] | |
| DN 50, EN flange PN 63 | EP | | | | | | | 625 [24.61] | 830 [32.68] | |
| DN 50, EN flange PN 100 | DH | | | | | | | 625 [24.61] | 830 [32.68] | |
| <hr/> | | | | | | | | | | |
| DN 65, EN flange PN 16 | EQ | | | | | | | | 830 [32.68] | |
| DN 65, EN flange PN 40 | DQ | | | | | | | | 830 [32.68] | |
| DN 65, EN flange PN 63 | ER | | | | | | | | 830 [32.68] | |
| DN 65, EN flange PN 100 | ES | | | | | | | | 830 [32.68] | |
| <hr/> | | | | | | | | | | |
| DN 80, EN flange PN 16 | ET | | | | | | | | 830 [32.68] | 915 [36.02] |
| DN 80, EN flange PN 40 | DJ | | | | | | | | 830 [32.68] | 915 [36.02] |
| DN 80, EN flange PN 63 | EU | | | | | | | | 830 [32.68] | 915 [36.02] |
| DN 80, EN flange PN 100 | DK | | | | | | | | 830 [32.68] | 915 [36.02] |

¹³⁾ Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.2.5. Slip on, process connection dim. + facing acc. EN 1092-1 Form B,
Installation length in mm [inch]

| Process connection ¹⁴⁾ | Code | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K |
|-----------------------------------|------|----------|----------|----------|----------|----------|----------|----------|-------------|-------------|
| DN 100, EN flange PN 16 | EV | | | | | | | | 830 [32.68] | 915 [36.02] |
| DN 100, EN flange PN 40 | DL | | | | | | | | 830 [32.68] | 915 [36.02] |
| DN 100, EN flange PN 63 | EW | | | | | | | | 830 [32.68] | 915 [36.02] |
| DN 100, EN flange PN 100 | DM | | | | | | | | 830 [32.68] | 915 [36.02] |
| DN125, EN flange PN 16 | EX | | | | | | | | | 915 [36.02] |
| DN125, EN flange PN 40 | DN | | | | | | | | | 915 [36.02] |
| DN125, EN flange PN 63 | EY | | | | | | | | | 915 [36.02] |
| DN125, EN flange PN 100 | DO | | | | | | | | | 915 [36.02] |
| DN150, EN flange PN 16 | DI | | | | | | | | | 915 [36.02] |
| DN150, EN flange PN 40 | DX | | | | | | | | | 915 [36.02] |

1.3.2.6. EN flange weld neck, Installation length in mm [inch]

| Process connection ¹⁴⁾ | Code | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K |
|---|------|----------|----------|----------|----------|-------------|-------------|-------------|----------|----------|
| DN 32, PN40 DIN 2635 – 1.4404/316L Type C Face | VO | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| DN 32, PN64 DIN 2636 – 1.4404/316L Type E Face | VP | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |
| DN 32, PN100 DIN 2637 – 1.4404/316L Type E Face | VQ | | | | | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |

1.3.2.7. Triclamp, Installation length in mm [inch]

| Process connection ¹⁴⁾ | Code | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K |
|-----------------------------------|------|------------|------------|------------|------------|-------------|-------------|-------------|----------|----------|
| ½" Triclamp | TA | 220 [8.66] | 220 [8.66] | 250 [9.84] | 250 [9.84] | | | | | |
| DN 25 Triclamp PN 16 DIN 32676 | TL | 210 [8.27] | 210 [8.27] | 240 [9.45] | 240 [9.45] | 460 [18.11] | 460 [18.11] | 625 [24.61] | | |

¹⁴⁾ Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.



1.3.2.8. Female Thread, Installation length in mm [inch]

| Process connection ¹⁵⁾ | Code | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K |
|-----------------------------------|------|---------------|---------------|---------------|---------------|----------------|----------------|----------|----------------|----------|
| 1/4" NPT female thread | FJ | 110 [4.33] | 110 [4.33] | 140 [5.51] | 140 [5.51] | | | | | |
| 3/4" NPT female thread | FL | 110 [4.33] | 110 [4.33] | 140 [5.51] | 140 [5.51] | 460 [18.11] | 460 [18.11] | | | |
| 1/2" NPT female thread | FK | 110 [4.33] | 110 [4.33] | 140 [5.51] | 140 [5.51] | 460 [18.11] | 460 [18.11] | | | |
| 2" NPT female thread | FQ | | | | | | | | 880 [34.65] | |
| 1/4" G, female thread | FB | 110 [4.33] | 110 [4.33] | 140 [5.51] | 140 [5.51] | | | | | |
| 3/8" G, female thread | FR | 110 [4.33] | 110 [4.33] | 140 [5.51] | 140 [5.51] | | | | | |
| 1/2" G, female thread | FC | 110 [4.33] | 110 [4.33] | 140 [5.51] | 140 [5.51] | 460 [18.11] | 460 [18.11] | | | |
| 5/8" G, female thread | FA | 110 [4.33] | 110 [4.33] | 140 [5.51] | 140 [5.51] | 460 [18.11] | 460 [18.11] | | | |

¹⁵⁾ Connections without installation length are not possible or need manufacturer release. Please contact the manufacturer.

1.3.3. Accessories

1.3.3.1. TRICOR Connection Cable (TCC) for panel-mounted housing

| | | | | | | | |
|---|------------------------------------|----------------------------|----------------|---|---|---|---|
| | | TCC | X | X | - | X | X |
| Cable Specifications/Connections | | | | | | | |
| Cable | Connector TCE | Connector TCM | Devices | | | | |
| Standard cable | SUB-D, 9-pin | cable end sleeves (8-pol.) | TCE 8**1-S- | 0 | 2 | | |
| Standard cable | SUB-D, 9-pin/ Din-Rail mounting | cable end sleeves (8-pol.) | TCE 8**1-S- | 0 | 4 | | |
| High temperature cable | SUB-D, 9-pin | cable end sleeves (8-pol.) | TCE 8**1-S- | 0 | 9 | | |
| High temperature cable | SUB-D, 9-pin/ Din-Rail mounting | cable end sleeves (8-pol.) | TCE 8**1-S- | 1 | 0 | | |
| Length | | | | | | | |
| 3 meter (Standard) | [≈ 10 ft.] | | | | | 0 | 3 |
| 6 meter | [≈ 20 ft.] | | | | | 0 | 6 |
| 10 meter | [≈ 33 ft.] | | | | | 1 | 0 |
| 15 meter | [≈ 49 ft.] | | | | | 1 | 5 |
| 20 meter | [≈ 66 ft.] | | | | | 2 | 0 |

1.3.3.2. Additional Accessories

| Accessories for TCE 8*** transmitter | Ordering Code |
|---|----------------------|
| USB interface cable to RS485, 1.8 m (TRICOR configurator) | CON.USB.RS-ISO |
| IP65 Protection for TCE-80**-S | IPS 9-9 |
| adapter TCE-80**-S and TCE-80**-L for rail mounting | HSA 96 |
| Service and calibration | Ordering Code |
| DAkkS-Calibration (ILAC) according to DIN EN ISO/IEC 17025:2005 | DAkkS-Calibration |
| Oxygen cleaning TCM | Oxygen cleaning TCM |
| Inspection certificate 3.1 according to DIN 50 049/EN 10204 | 3.WKZ-0100 |
| TAG Plate 1.4404 [AISI 316L] | TCM-Tag-Plate-1.4404 |

1.4. Measuring Principle TCM

Two parallel flow tubes inside the TCM Flow Meter are vibrating at their natural frequency in opposite direction. Any mass flow passing through the tubes will delay the vibration at the incoming side and accelerate the vibration at the outgoing side. This causes a small time shift between both ends of the tube. This time shift is measured and used to calculate the mass flow through the tubes.

By measuring the natural frequency of the tubes the density of the medium can be calculated.

As both effects are temperature dependent, the temperature is measured by means of an accurate temperature sensor for correcting the temperature effects on flow and density measurement.

As a result a Coriolis Mass Flow Meter measures directly mass flow, density and temperature of the medium. Knowing the mass flow and the density, also the volume flow can be calculated.

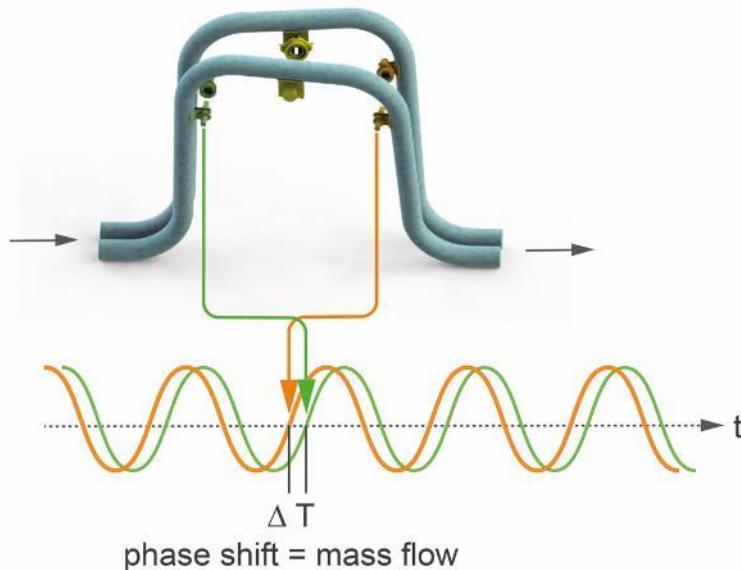


Fig. 5: Principle of operation Coriolis Mass Flow Meter



2. Getting Started

2.1. Unpacking

Verify that you have received the following items:

When you ordered a compact version:

- TCM **** with mounted transmitter
- Instruction manual (printed booklet or www.tricorflow.com/manuals/)

When you ordered a remote version:

- TCM **** with junction box
- TCE 8***
- Connecting cable (for TCE 8***-wall mounted just fixed to the TCE, TCE 8*** with separated cable)
- Instruction manual (printed booklet or www.tricorflow.com/manuals/)

2.2. Operating Elements

2.2.1. TCE 8***-wall mounted and compact version

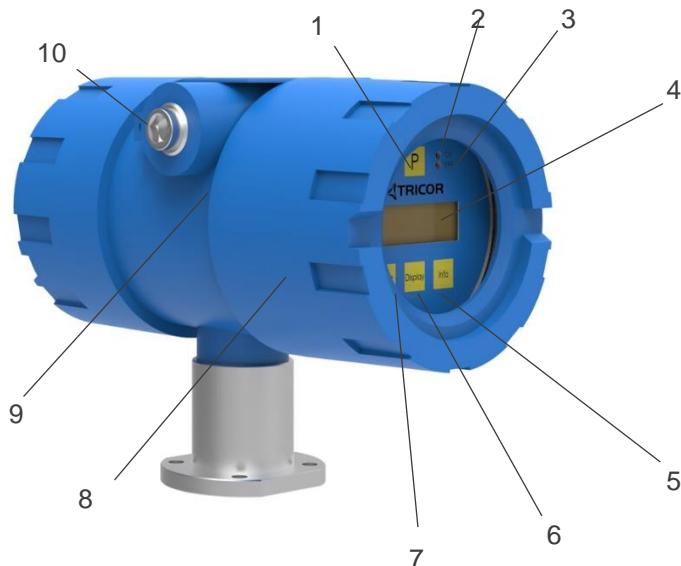


Fig. 6: Operating Elements of TCE 8***-W and compact version

- 1 = Pushbutton "P", activates/selects the different menus and confirms the settings
- 2 = LED "OK", flashes green when there is no error
- 3 = LED "ERR", flashes red when an error occurs
- 4 = Display
- 5 = Pushbutton "Info", normal: selects the error menu, setup mode: softkey
- 6 = Pushbutton "Display", normal: toggles the display, setup mode: softkey
- 7 = Pushbutton "Reset", normal: resets the BATCH TOTAL counter, setup mode: softkey
- 8 = Front cover
- 9 = Set screw for front cover (varying position)
- 10 = Screw for protective ground

Wall mount electronics only (not shown on the picture):

- Cable to the TCM sensor, length as ordered (standard: 3 m [10 ft.])
- Wall mounting bracket



2.2.2. TCE 8***-panel mounted

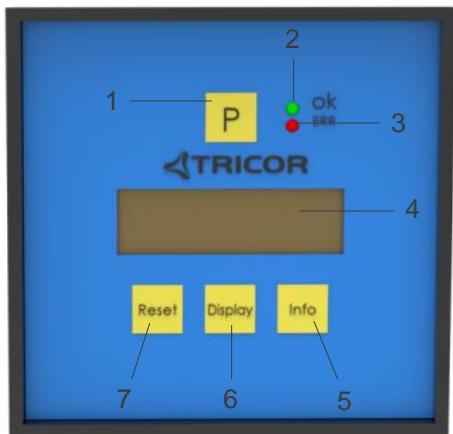


Fig. 7: Operating Elements of TCE 8***-S

- 1 = Pushbutton "P", activates/selects the different menus and confirms the settings
- 2 = LED "OK", flashes green when there is no error
- 3 = LED "ERR", flashes red when an error occurs
- 4 = Display
- 5 = Pushbutton "Info", normal: selects the status menu, setup mode: softkey
- 6 = Pushbutton "Display", normal: toggles the display, setup mode: softkey
- 7 = Pushbutton "Reset", normal: resets the batch counter, setup mode: softkey

For the rear view see chapter 2.3.3.

2.2.3. TCM **** (remote version) terminal

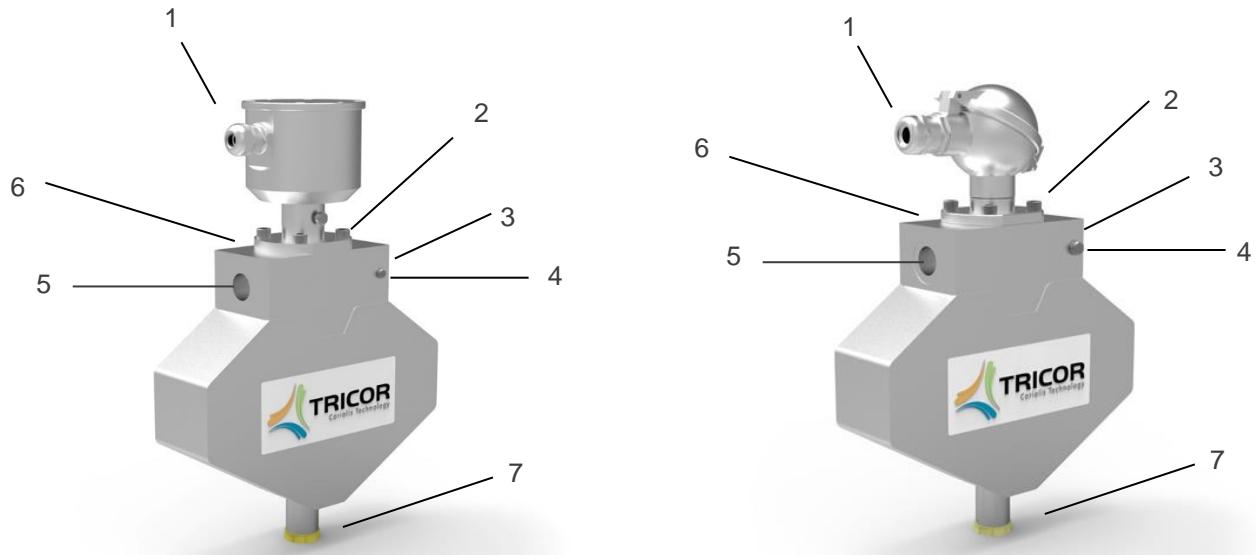


Fig. 8: Operating Elements TCM

- 1 = Cable gland for cable to the TCE
- 2 = Locking screw for screw type terminals
- 3 = Screw for protective ground (TCM 0325 through 3100 only)
- 4 = Fluid output, flange/thread as ordered
- 5 = Fluid input, flange/thread as ordered
- 6 = M6 mounting threads (back side, option, TCM 0325 through 3100 only)
- 7 = Rupture Disc (burst pressure: 4 bar [58 psi])

| Terminal | Signal | Color/Mark | |
|----------|------------|---------------------------------------|---------------------------------------|
| | | Temperature range ≤100 °C [212 °F] | Temperature range >100 °C [212 °F] |
| 1 | Driver + | Gray/1 | Gray/1 |
| 2 | Driver - | Pink/2 | Gray/2 |
| 3 | Sensor A + | Blue/3 | Gray/3 |
| 4 | Sensor A - | Red/4 | Gray/4 |
| 5 | Sensor B + | White/5 | Gray/5 |
| 6 | Sensor B - | Brown/6 | Gray/6 |
| 7 | PT1000 + | Green/7 | Gray/7 |
| 8 | PT1000 - | Yellow/8 | Gray/8 |

Tab. 1: Connections TCM ****



Junction box – Type A (Aluminum)



Fig. 9: Electrical terminals Junction box – Type A (Alu)

Junction box – Type H (1.4404 [316L])

Medium temperature range $\leq 100\text{ }^{\circ}\text{C}$ [212 $^{\circ}\text{F}$]

Junction box – Type H (1.4404 [316L])

Medium temperature range $>100\text{ }^{\circ}\text{C}$ [212 $^{\circ}\text{F}$]

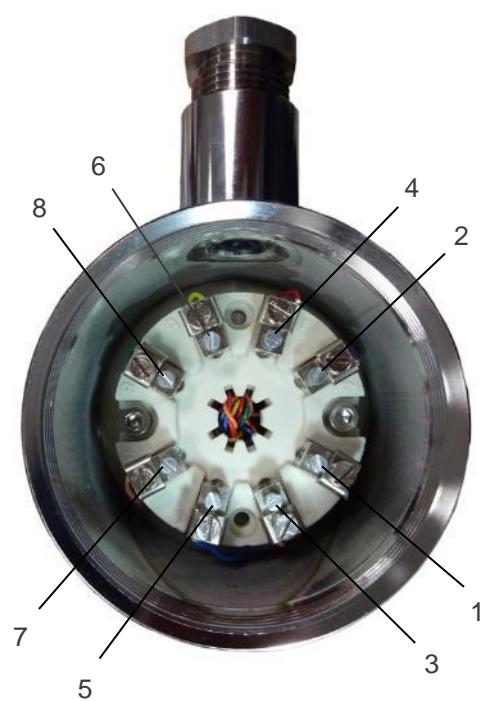
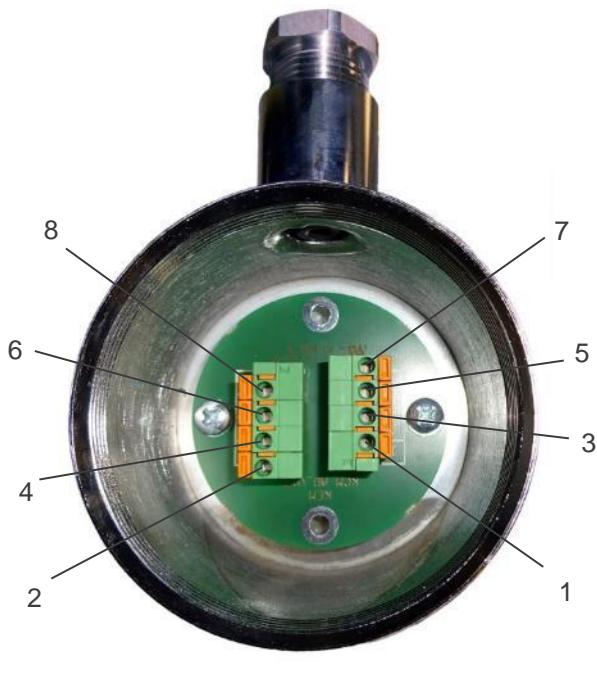


Fig. 10: Electrical terminals Junction box – Type H (1.4404 [316L])

2.3. Pin Assignments

2.3.1. TCE 8***-wall mounted and compact version, non-Ex

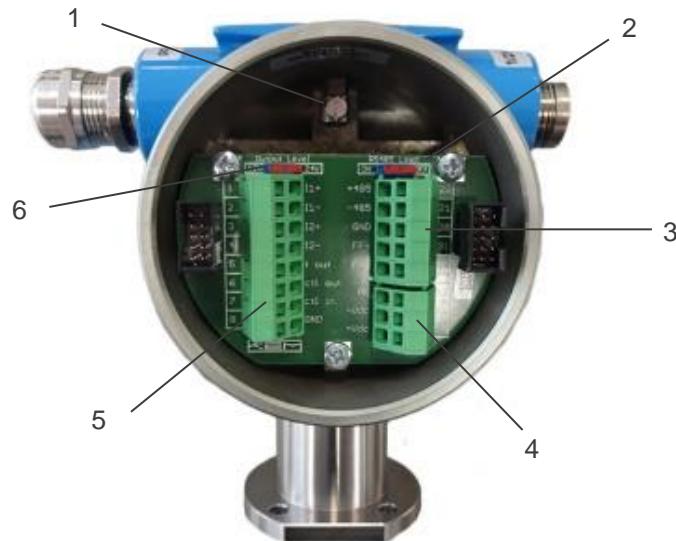


Fig. 11: Electrical terminals TCE 8***-W and compact version

- 1 = Terminal screw for protective ground
- 2 = Switch for terminating resistor for the RS485 interface
- 3 = Terminal block for interface
- 4 = Terminal block power supply
- 5 = Terminal block for I/O signals
- 6 = Switch for output level (12 V/24 V) of the frequency and control output



TCE Terminal Connections

| | | |
|----|--------------------|------------------------------------|
| 1 | +I1 | Current loop 1 positive terminal |
| 2 | -I1 | Current loop 1 negative terminal |
| 3 | +I2 | Current loop 2 positive terminal |
| 4 | -I2 | Current loop 2 negative terminal |
| 5 | F _{OUT} | Frequency/pulse output |
| 6 | CTL _{OUT} | Control output |
| 7 | CTL _{IN} | Control input |
| 8 | GND | Ground (for pins 5 through 7) |
| 20 | COMMON | Common (for pins 21 and 22) |
| 21 | -RS485 | RS485 negative line |
| 22 | +RS485 | RS485 positive line |
| 30 | COMMON | Common (for pins 31 and 32) |
| 31 | FF- | Foundation Fieldbus® negative line |
| 32 | FF+ | Foundation Fieldbus® positive line |

24 V DC Supply

| | | |
|----|-------|-----------------------------------|
| 50 | +V DC | Positive supply voltage (24 V DC) |
| 51 | -V DC | Supply ground |
| 52 | PE | Protective Ground |

100 ... 240 V AC Supply

| | | |
|----|----|--------------------|
| 90 | L | Phase (AC voltage) |
| 91 | N | Neutral |
| 52 | PE | Protective Ground |

NOTE:

With option "PRESSURE COMPENSATION" the current loop 1 (Terminal 1 and 2) is an input.

2.3.2. TCE 8***-wall mounted and compact version, Ex certified

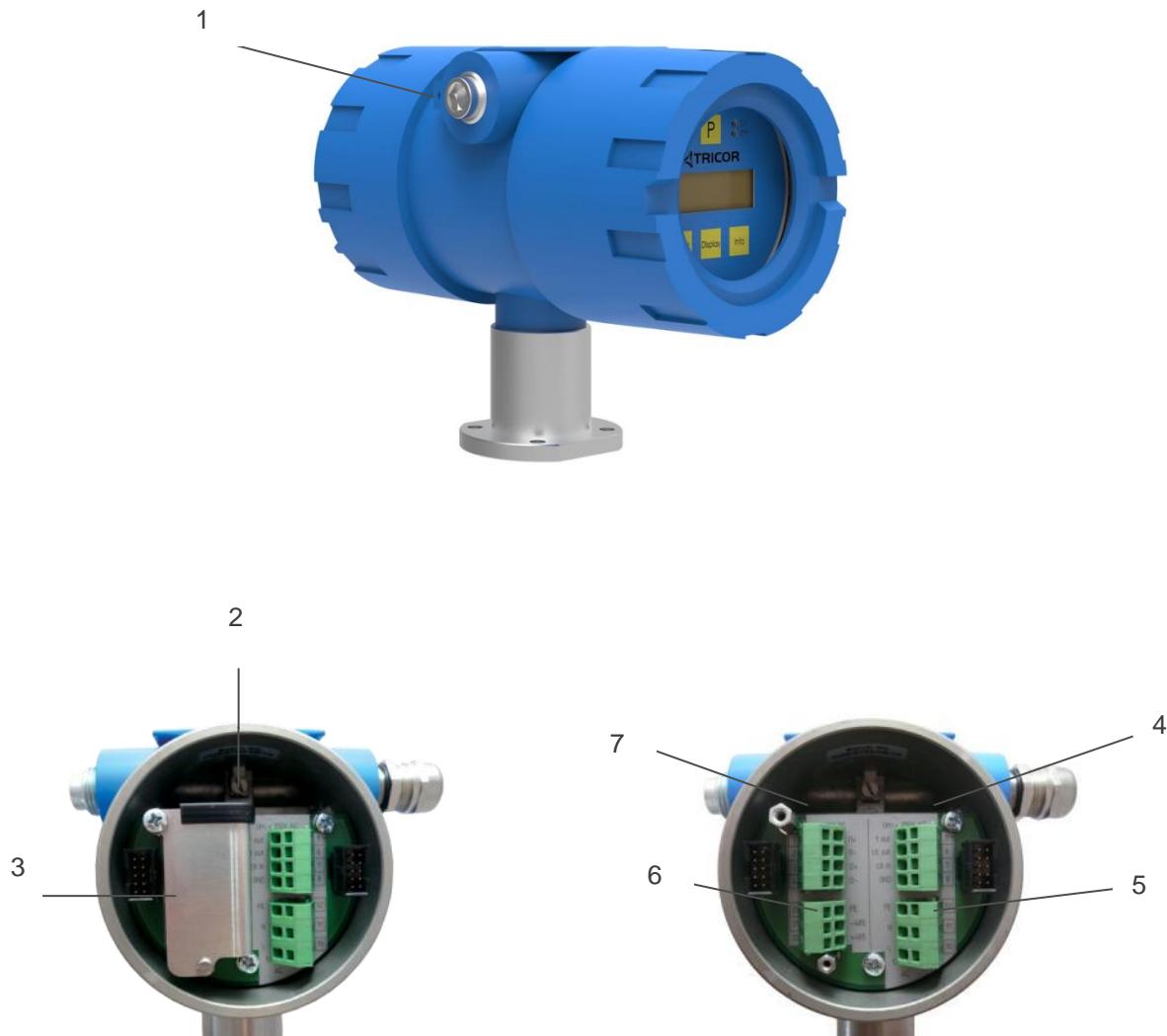


Fig. 12: Electrical terminals TCE 8***-W-*-Ex

- 1 = Terminal screw for protective ground
- 2 = Terminal screw for protective ground
- 3 = Protective cover
- 4 = Terminal block for digital I/O signals ($U_M = 250$ V DC)
- 5 = Terminal block power supply ($U_M = 250$ V DC)
- 6 = Terminal block for interface ($U_M = 30$ V DC)
- 7 = Terminal block for analog I/O signals ($U_M = 30$ V DC)



TCE Terminal Connections

Terminals with $U_M = 30 \text{ V DC}$

| | | |
|----|--------|------------------------------------|
| 1 | +I1 | Current loop 1 positive terminal |
| 2 | -I1 | Current loop 1 negative terminal |
| 3 | +I2 | Current loop 2 positive terminal |
| 4 | -I2 | Current loop 2 negative terminal |
| 20 | COMMON | Common (for pins 21 and 22) |
| 21 | -RS485 | RS485 negative line |
| 22 | +RS485 | RS485 positive line |
| 30 | COMMON | Common (for pins 31 and 32) |
| 31 | FF- | Foundation Fieldbus® negative line |
| 32 | FF+ | Foundation Fieldbus® positive line |

Terminals with $U_M = 250 \text{ V DC}$

| | | |
|---|-------------|-------------------------------|
| 5 | F_{OUT} | Frequency/pulse output |
| 6 | CTL_{OUT} | Control output |
| 7 | CTL_{IN} | Control input |
| 8 | GND | Ground (for pins 5 through 7) |

24 V DC Supply

| | | |
|----|-------|-----------------------------------|
| 50 | +V DC | Positive supply voltage (24 V DC) |
| 51 | -V DC | Supply ground |
| 52 | PE | Protective Ground |

100...240 V AC Supply

| | | |
|----|----|--------------------|
| 90 | L | Phase (AC voltage) |
| 91 | N | Neutral |
| 52 | PE | Protective Ground |

NOTE:

With option "PRESSURE COMPENSATION" the current loop 1 (Terminal 1 and 2) is an input.

2.3.3. Panel Mount version, non-Ex

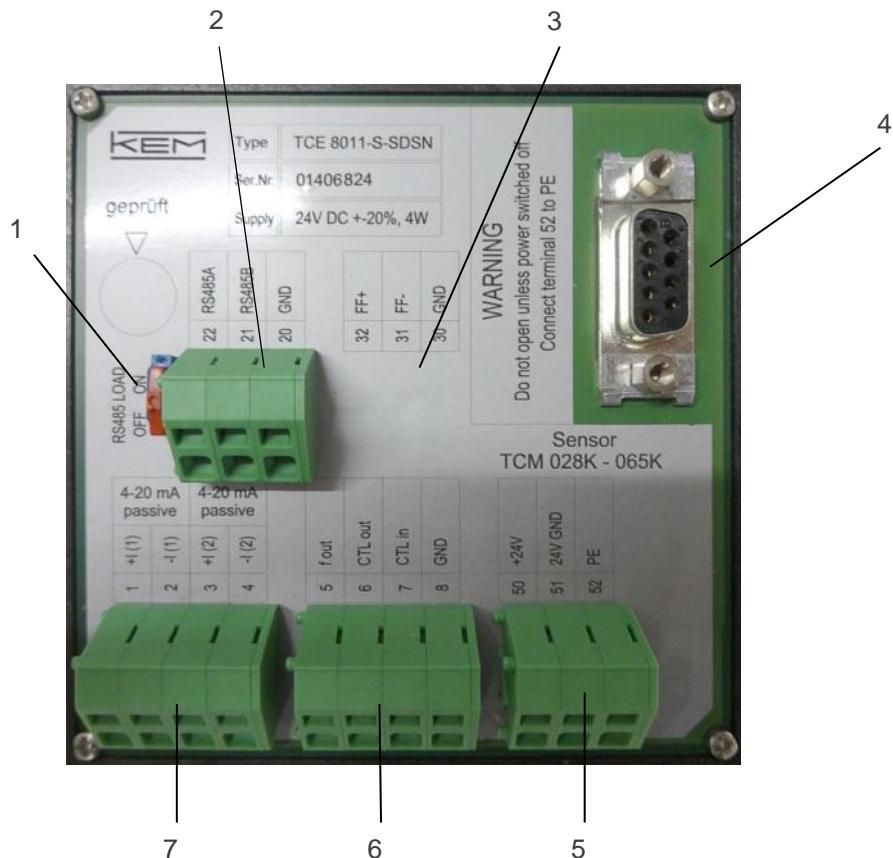


Fig. 13: Electrical terminals TCE 8***-S

- 1 = Sliding switch for activating the $120\ \Omega$ terminal resistance for RS485
- 2 = Cage clamp terminals for interface RS485
- 3 = Cage clamp terminals for interface Foundation Fieldbus® (option) or relay terminals (option)
- 4 = Connector to the meter, D-SUB, 9-pin, female
- 5 = Cage clamp terminals for power supply
- 6 = Cage clamp terminals for digital I/O signals
- 7 = Cage clamp terminals for analog I/O signals



TCE Terminal Connections

| | | |
|----|--------------------|------------------------------------|
| 1 | +I1 | Current loop 1 positive terminal |
| 2 | -I1 | Current loop 1 negative terminal |
| 3 | +I2 | Current loop 2 positive terminal |
| 4 | -I2 | Current loop 2 negative terminal |
| 5 | F _{OUT} | Frequency/pulse output |
| 6 | CTL _{OUT} | Control output |
| 7 | CTL _{IN} | Control input |
| 8 | GND | Ground (for pins 5 through 7) |
| 20 | COMMON | Common (for pins 21 and 22) |
| 21 | -RS485 | RS485 negative line |
| 22 | +RS485 | RS485 positive line |
| 30 | COMMON | Common (for pins 31 and 32) |
| 31 | FF- | Foundation Fieldbus® negative line |
| 32 | FF+ | Foundation Fieldbus® positive line |
| 50 | +24 V DC | Positive supply voltage (24 V DC) |
| 51 | -24 V DC | Supply ground |
| 52 | PE | Protective Ground |
| 90 | L | Phase (AC voltage) |
| 91 | N | Neutral |
| 52 | PE | Protective Ground |

Without Foundation Fieldbus® interface there are no terminals 30 ... 32.

With option "Relay Out" there are the relay terminals:

| | | |
|----|---------|-------------------------------|
| 40 | REL NO | Relay normally open contact |
| 41 | REL COM | Relay common |
| 42 | REL NC | Relay normally closed contact |

NOTE:

With option "PRESSURE COMPENSATION" the current loop 1 (Terminal 1 and 2) is an input.

2.4. Device Marking

2.4.1. Compact Version

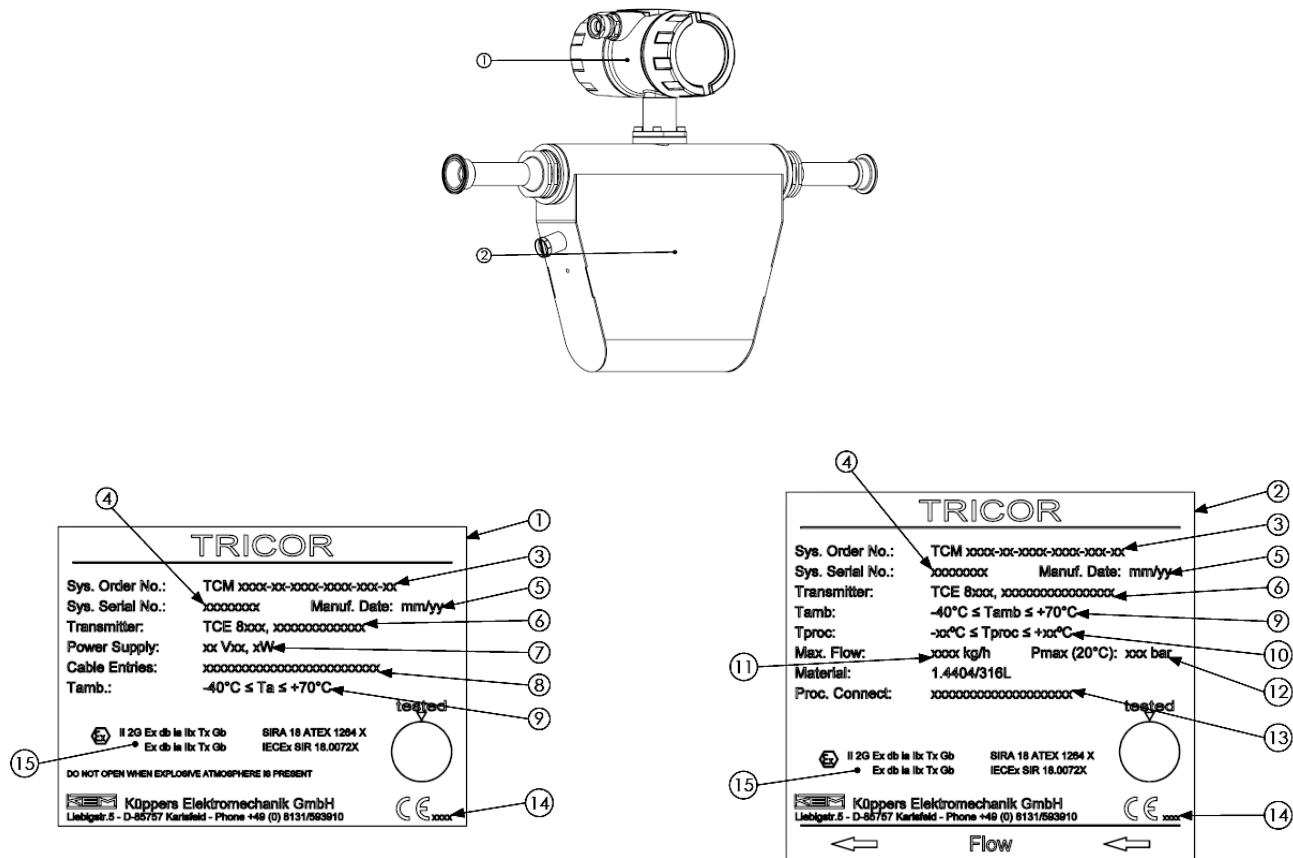


Fig. 14: Device marking TCM compact version

| | | | |
|-----|--------------------------|------|--------------------------------------|
| (1) | Transmitter Label | (9) | Ambient Temperature Range |
| (2) | Sensor Label | (10) | Process Temperature Range |
| (3) | System Order No. | (11) | Maximum Rated Flow |
| (4) | System Serial No. | (12) | Maximum Rated Pressure 20 °C [68 °F] |
| (5) | Manufacturing Date | (13) | Process Connection |
| (6) | Transmitter | (14) | ID of the Notification Body |
| (7) | Transmitter Power Supply | (15) | Certification (optional) |
| (8) | Cable Entry | | |



2.4.2. Remote Version

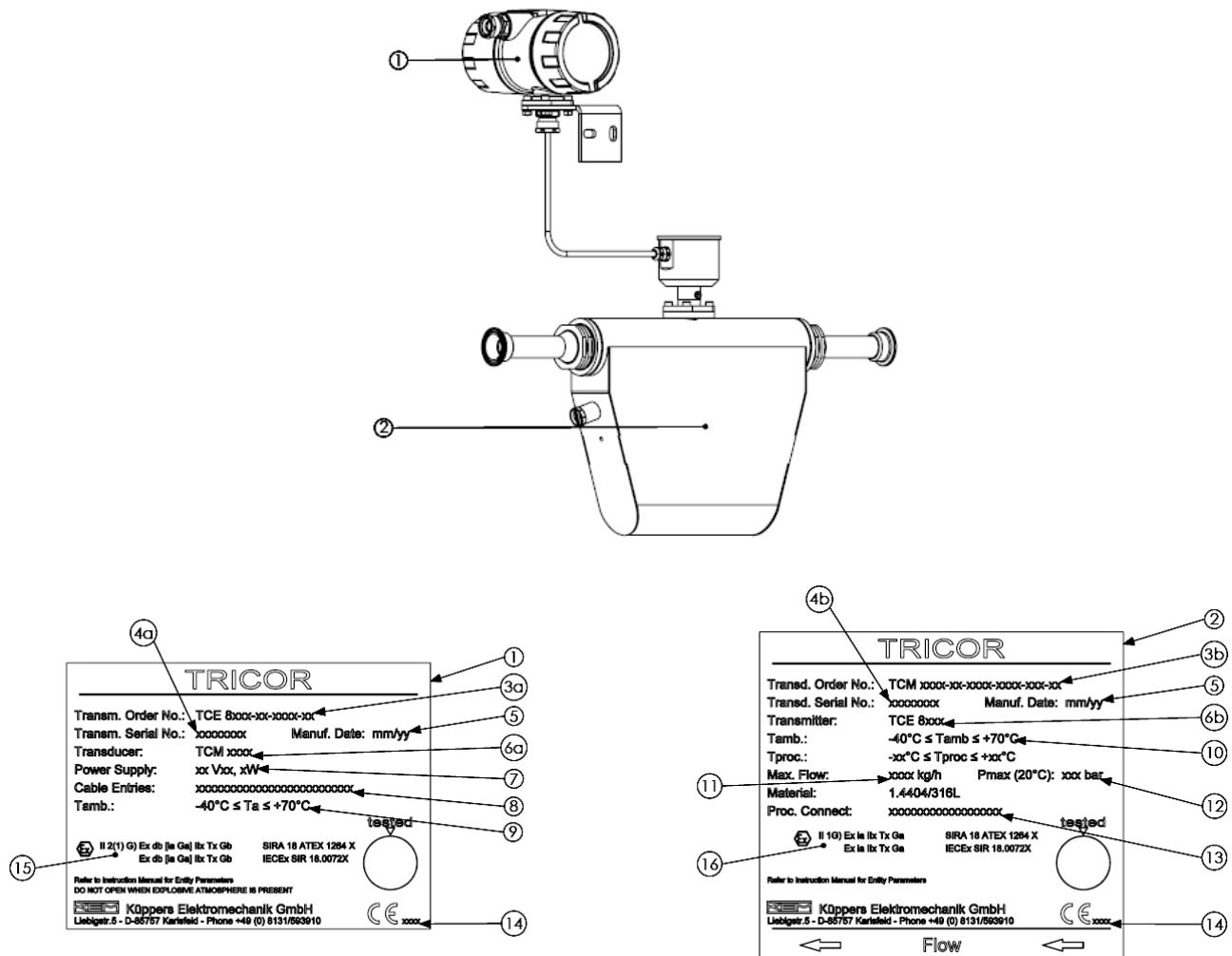


Fig. 15: Device marking TCM remote version

| | | | |
|-----|---------------------------|------|--------------------------------------|
| (1) | Transmitter Label | (8) | Cable Entry |
| (2) | Sensor Label | (9) | Ambient Temperature Range |
| (3) | a: Transmitter Order No. | (10) | Process Temperature Range |
| | b: Sensor Order No. | (11) | Maximum Rated Flow |
| (4) | a: Transmitter Serial No. | (12) | Maximum Rated Pressure 20 °C [68 °F] |
| | b: Sensor Serial No. | (13) | Process Connection |
| (5) | Manufacturing Date | (14) | ID of the Notification Body |
| (6) | a: Sensor Type | (15) | Certification Ration TCE (optional) |
| | b: Transmitter Type | (16) | Certification Ration TCM (optional) |
| (7) | Transmitter Power Supply | | |

2.5. Quick Start

WARNING!

As for safety and accuracy reasons many precautions must be taken, read chapter 3 carefully before installing the TCM.

In case the TCM has only to be operated without flow for testing or learning purpose, at least the following connections have to be made (see chapter 3.3):

- Connect the TCE to the TCM (only required with the separate version)
- Connect the supply voltage
- The various inputs and outputs as well as the interface may be connected as well, if those features are required.

WARNING!

If the TRICOR CLASSIC Mass Flow Meter is connected to a bigger system, for your personal safety connect the protective ground as well!

WARNING!

In hazardous areas it is not allowed to operate the TRICOR CLASSIC Coriolis Mass Flow Meter without proper wiring in accordance with chapter 3.3.8 and with the housing not properly closed!

2.5.1. First Operation

Make sure that all mechanical and electrical connections are made properly.

Switch on the power supply. The LED “OK” will flash green.

After the power up sequence the display shows the preselected values (ex factory: “FLOW” and “BATCH”)

Switch on the flow. The value indicated in the display should be positive.

In case of an error the LED “ERR” will flash red.

As soon as the TCM has reached the operating temperature, make the zero point calibration (see chapter 4.2.2 and 4.5.3 for detailed information):

- Switch off the flow
- Wait until the flow through the TCM is zero
- Start the zero offset calibration in the “ZERO OFFSET” menu
- Wait until the offset procedure is finished
- Switch on the flow again

The display can be altered by pressing the pushbutton “Display”.

The internal device status can be viewed by pressing the pushbutton “Info”.

If the function is activated, the BATCH reading can be reset to zero by pressing the pushbutton “Reset”.

To open the control menu press button “P” for three seconds.



2.5.2. CONTROL Menu

In the “CONTROL” menu all configurations can be made. This includes configuration of the analog and digital outputs, customizing the display and other settings.

The menu itself is self-explaining; the function of the softkeys is indicated in the display above the pushbuttons.

To enter the “CONTROL” menu press the pushbutton “P” for three seconds.

If a global access code is set, the “CONTROL” menu is completely locked (see chapter 6.7).

With no global access code the submenu “DISPLAY” can be entered without a password as any changes in this submenu will not affect the operation of the TCM.

The submenus “ZERO OFFSET”, “SETUP”, “I/O-TEST” and “SERVICE” are password protected for avoiding unintentional changes of the operating parameters.

For “ZERO OFFSET”, “SETUP” and “I/O-TEST” the password is “2207”, for “SERVICE” refer to chapter 6.

Change the indicated number “2206” with the softkey “UP” to “2207” and confirm with “P”.

Select the desired submenu with the softkeys and confirm with “P”.

Every setting must be confirmed with “P” for storing the setting or with “EXIT” for exiting without storing.

For leaving the “SETUP” menu press “EXIT” until the TCE returns to the main level.

2.5.3. Using the magnet

The explosion-proof variants with the blue Ex d housings provide a magnet to be able to operate the pushbuttons without opening the display cover.

In hazardous, wet and dusty areas the display cover must not be opened to operate the pushbuttons.

Beside every pushbutton there is a hall sensor which can be operated via the magnet attached to the housing.

For operating the pushbuttons hold the magnet to the glass.

The best positions for operating the keys are:

| Pushbutton | Position |
|------------|------------------------------------|
| P | left upper edge of the yellow area |
| Reset | lower edge of the yellow area |
| Display | lower edge of the yellow area |
| Info | lower edge of the yellow area |



3. Installation

3.1. Important Installation Guidelines

Coriolis Mass Flow Meters measure the flow of a liquid or gas by vibrating the medium perpendicular to the flow direction and measuring the effect of the inertial force of the medium. Consequently, for best performance the meter must be decoupled from external vibrations and the medium must be homogenous.

It is recommended to install a valve before and after the meter. For the zero calibration both valves should be closed.

3.1.1. External Vibrations

In case of (possible) external vibrations connect the meter mechanically rigidly to a non-vibrating point or – if this is not possible – connect it by means of vibration dampers.

The small meters (TCM 0325 through TCM 3100) can be mounted via optional mounting threads or mounting holes (TCMH 0450) on the back side. All other meters must not be fixed directly, but via holders connected to the external tubing, as close as possible to the flanges of the meter.

In case of vibrating tubes a decoupling via flexible hoses might be recommended.

Piston pumps and other pumps producing a strongly pulsating flow should be decoupled hydraulically via longer pipes, flexible tubes or other measures.

High pressure changes in short intervals over long time period should be avoided! If it is though an application requirement, please contact our internal sales for technical support!

3.1.2. Inhomogeneous Media

If a liquid might contain gas bubbles or solid particles, care must be taken that the gas bubbles or the solid particles will not remain in the meter.

If a pure liquid or a liquid with possible gas bubbles is to be measured, the meter should be installed horizontally with the meter tubes down. This assures that gas bubbles will not accumulate in the measuring tubes. Meters with U-shaped tubes (TCM 5500 and bigger) can also be mounted vertically.

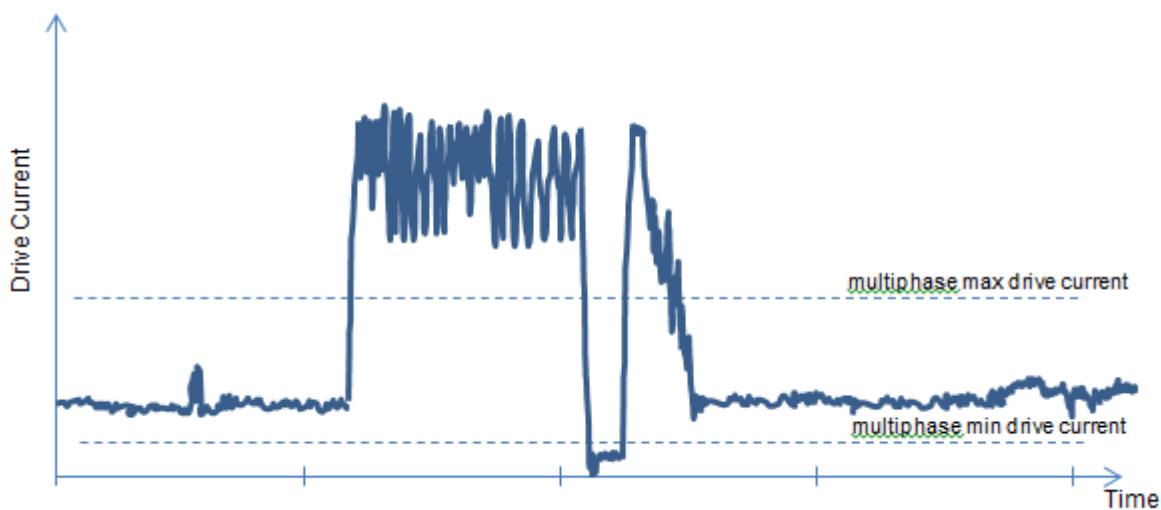
If a liquid might contain solid particles, the meter should be installed horizontally with the meter tubes up. This assures that the solid particles will not accumulate in the measuring tubes. Meters with U-shaped tubes (TCM 5500 and bigger) can also be mounted vertically.

The TCM 0325 through TCM 3100 and TCMH 0450 must not be mounted vertically, as according to the diamond shaped tube geometry gas bubbles as well as solid particles would accumulate in the meter.

Two phase media with gas bubbles (like foam) or solid particles (like paints or slurry) can be measured without any problems, if the gas bubbles or solid particles are small compared to the tube diameter and evenly distributed. The mounting guidelines, must be observed.

If the amount of gas in the measured fluid or vice versa the amount of fluid in the measured gas goes to high, the flow and density readings get significantly disturbed. The disturbances can be properly detected by means of the measured drive current.

To suppress the faulty measurements, you can define a valid drive current range by specifying drive current thresholds “max drive current” and “min drive current”, as shown in the picture below:



As long as the current drive current stays within the valid range, the flowrate and density will be calculated based on the analog inputs. Otherwise the input signals will be suppressed and the process parameter flow rate and density are set to 0 g/s and 0.001 g/cc.

The drive current thresholds can be specified by means of TRICOR Configurator. The software is license free and can be downloaded from our web site:

www.kem-kueppers.com/en/service/downloads/software.html

3.1.3. Density CUT OFF for Gas

If you change from liquid applications to gas applications make sure to change to the DENSITY CUT OFF to 0.0 [units] (see chapter 4.5.6.3).

3.2. Mechanical Installation

In accordance with this manual the user should select the installation position which fits the application best. To ensure the highest degree of accuracy and repeatability, care should be taken to affix the TRICOR CLASSIC products in a stable process site and minimize the amount of vibration in the installation environment.

3.2.1. Basic Safety Notes

CAUTION!

Hot surfaces resulting from hot process media

Risk of burns resulting from surface temperatures above 70 °C [155 °F].

Take appropriate protective measures, for example contact protection.

Make sure that protective measures do not cause the maximum permissible ambient temperature to be exceeded. Refer to the information in "Technical Data" (see chapter 7.3).

NOTE:

Hot surface is only an issue for media or ambient temperature above 50 °C [122 °F].

WARNING!

Wetted parts unsuitable for the process media

Risk of injury or damage to device.

Hot, toxic and corrosive media could be released if the process medium is unsuitable for the wetted parts.

Ensure that the material of the device parts wetted by the process medium is suitable for the medium. Refer to the information in "Technical Data" (see chapter 7.3).

NOTE:

Material compatibility

The manufacturer can provide you with support concerning selection of sensor components wetted by process media. However, you are responsible for the selection of components. The manufacturer accepts no liability for faults or failures resulting from incompatible materials.

WARNING!

Unsuitable process connections

Risk of injury or poisoning.

In case of improper mounting hot, toxic and corrosive process media could be released at the connections.

Ensure that process connections (such as flange gaskets and bolts) are suitable for connection and process media.

WARNING!

Exceeded maximum permissible operating pressure

Risk of injury or poisoning.

The maximum permissible operating pressure depends on the device version, pressure limit and temperature rating. The device can be damaged if the operating pressure is exceeded. Hot, toxic and corrosive process media could be released.

Ensure that maximum permissible operating pressure of the device is not exceeded. Refer to the information on the sensor nameplate and/or in "Technical Data" (see chapter 7.3).



WARNING!

Unprotected cable ends

Risk of explosion through unprotected cable ends in hazardous areas.

Protect unused cable ends in accordance with IEC/EN 60079-14.

WARNING!

Loss of explosion protection

Risk of explosion in hazardous areas if the device is open or not properly closed.

Close the device as described in “Electrical Installation” (see chapter 3.3).

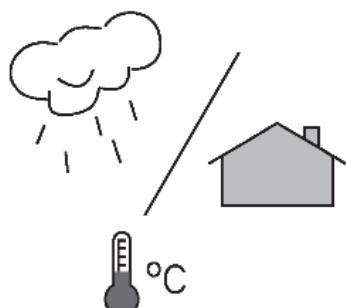
CAUTION!

External stresses and loads

Damage to device by severe external stresses and loads (e.g. thermal expansion or pipe tension). Process media can be released.

Prevent severe external stresses and loads from acting on the device.

3.2.2. Installation Location Requirements



TRICOR TCMP Series Flow Meters has IP65 rating by default. With the optional IP67/NEMA 4X enclosure rating the meters are suitable for indoor and outdoor installations.

Process pressure and medium temperature

If applicable, make sure that specifications for rated process pressure (PS) and medium temperature (TS) plus ambient temperature that are indicated on the device nameplate/label will not be exceeded.

Aggressive atmospheres

Ensure that the device is suitable for the application and that it is installed where there is no risk of penetration of aggressive vapors.

Direct sunlight

Prevent the device from overheating or materials becoming brittle due to UV exposure by protecting it from direct sunlight. Make sure that the maximum permissible ambient temperature is not exceeded. Refer to the information in “Technical Data” (see chapter 7.3).

WARNING!

Equipment used in hazardous areas

Risk of explosion in hazardous areas.

Special requirements apply to the location and installation of the device. See “Electrical Installation” (chapter 3.3.1 to 3.3.5).

WARNING!**Strong vibrations**

Risk of explosion in hazardous areas.

In plants with strong vibrations, mount the transmitter in a low vibration environment.

CAUTION!**Strong vibrations**

Damage to device

In plants with strong vibrations, mount the transmitter in a low vibration environment away from the sensor.

3.2.3. Horizontal Installation

The horizontal installation is the recommended installation.

If the medium might contain solid particles, mount the meter as shown in position "A", in all other cases as shown in position "B".

Install the meter to a solid, non-vibrating surface as close to the meter as possible. With the TCM 0325 through TCM 3100 this could be done via the optional mounting threads or with the TCMH 0450 via the mounting holes.

If no non-vibrating surface is available, vibration dampers might be recommended.

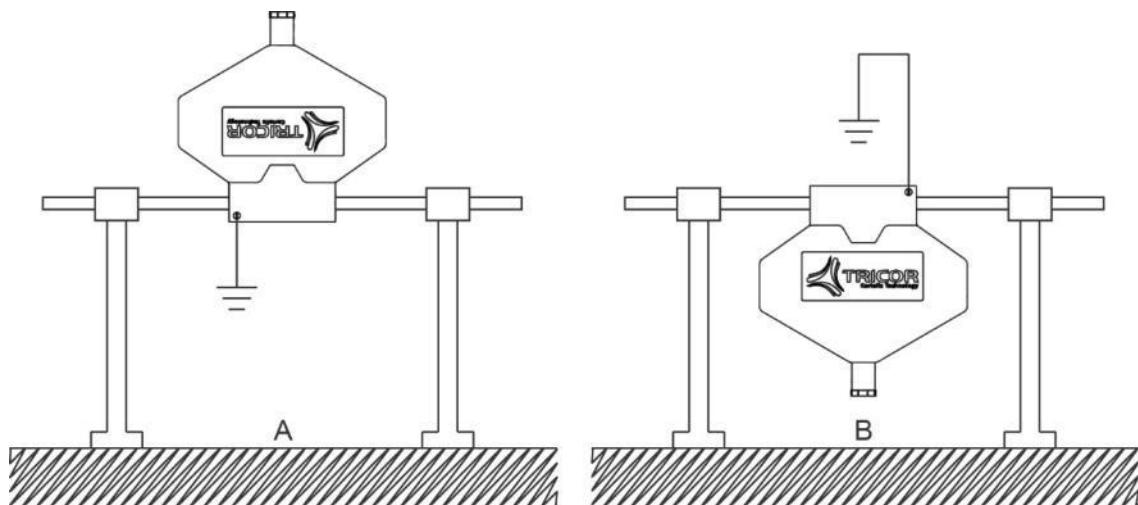


Fig. 16: Recommended horizontal Installation



3.2.4. Vertical Installation

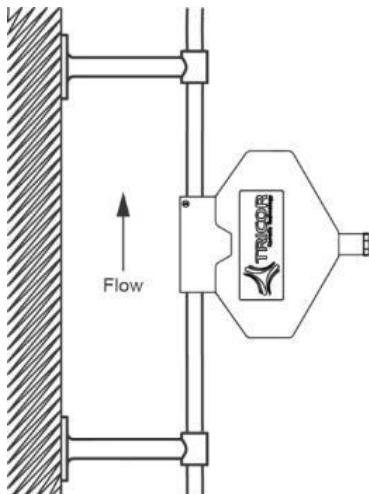


Fig. 17: Vertical Installation

TCMH Mass Flow Meters for high pressure applications (>400 bar [5,800 psi]) should not be mounted in vertical position.

The diamond shaped TCM 0325 through TCM 3100 should not be mounted vertically except you are sure that the medium contains neither gas bubbles nor solid particles.

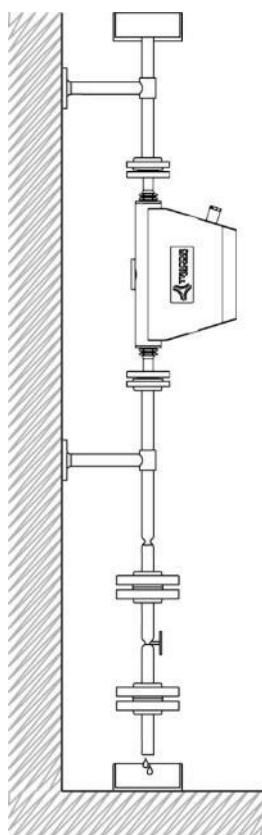
All other meters can be mounted vertically. This would be the recommended position, if the medium might contain gas bubbles and solid particles.

It is recommended to mount the meter in an upstream position for avoiding that it runs empty during operation.

Fix the meter to a solid, non-vibrating surface as close to the meter as possible.

If no non-vibrating surface is available, vibration dampers might be recommended.

3.2.5. Installation in a Drop line



The diamond shaped TCM 0325 through TCM 3100 should not be mounted vertically except you are sure that the medium contains neither gas bubbles nor solid particles.

TCMH Mass Flow Meters for high pressure applications (>400 bar [5,800 psi]) should not be mounted in vertical position.

All other meters can be mounted vertically, but flow going down is only allowed as long as there is significant backpressure on the meter to prevent any type of waterfall effect and to assure the meter remains constantly full of the liquid.

Fig. 18: Installation in a Drop Line

3.2.6. Critical Installations

The meters must not be mounted at the highest point of the tubing (A), if gas bubbles are to be expected, or at the lowest point (B), if solid particles are to be expected, as in both cases also the right mounting position might not help.

Also the meters must not be mounted in a drop line near the open end (C), as in that case the meter might run empty.

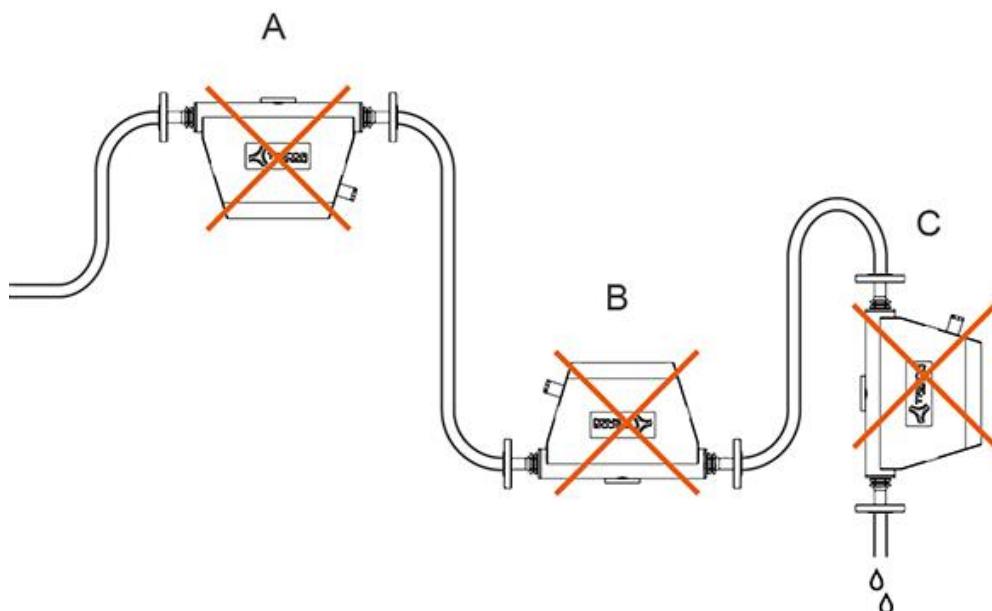


Fig. 19: Critical Installations

3.2.7. Mechanical Installation of the Transmitter

TCE 8***-W

The wall mount TCE is to be mounted on the wall with 2 screws with 5 mm diameter, about 40 mm apart. For exact dimensions refer to chapter 7.3.7.

TCE 8***-S

The housing requires an opening in the panel of 92 x 92 mm (TCE 8***-S) at a maximum panel thickness of 2 mm.

Push the TCE 8*** into the opening. The springs will fix the unit automatically.

For removing the TCE 8*** press the springs towards the housing via a screwdriver.

WARNING!

For mounting the TCM in hazardous areas refer to the "Control drawing for hazardous areas".



3.3. Electrical Installation

Make sure that the TCM is properly mounted and the process input and output are connected before making the electrical connections.

The TCM must be grounded.

The TCE requires a regulated power supply of 24 V DC or a mains voltage of 100 to 240 V AC, depending on the version.

WARNING!

Never connect a 24 V only version to the mains supply or vice versa!

The digital inputs and outputs are referred to GND and to the ground potential of the DC supply (= negative pole). The AC supply terminals are electrically isolated from all inputs and outputs.

The ground potential GND is connected to protective ground via a 1 kΩ resistor. The resistor will thermally withstand a potential difference of up to 30 V between PE and GND but for proper operation this difference should be limited to 5 V.

To connect the TCE, shielded cables must be used. The shield should be connected to the case. If the TCM is installed in bigger systems and the shield must not present a DC connection for avoiding high ground loop currents, make the ground connection of the shield via a capacitor of e.g. 100 nF.

WARNING!

Improper grounding and shielding may lead to bad EMC behavior or danger to your health!

NOTE:

Make sure that all cable and wires are connected and fixed properly before applying power to the TCE.

WARNING!

Always switch off the voltage supply before you wire the analog or digital in- and outputs or communication interface.

3.3.1. Locating the Compact Version

The TCM ***-**-****-C (K, M or O) - **** -Ex is explosion proof with Ex d for the transmitter and Ex i for the meter.

The inputs and outputs are not power limited and must not be used to drive intrinsically safe circuits.

WARNING!

Never open any cover of the transmitter in hazardous locations with any supply or I/O circuits alive!

3.3.2. Locating the Remote Version with TCE 8***-W(I)-****-Ex (wall mounted)

NOTE:

For use in hazardous locations the TCM as well as the TCE must be Ex versions!

The TCM ***-**-****-****-Ex is intrinsically safe when driven by the corresponding TCE 8***-Ex.

The TCE 8***-wall mounted-****-Ex is explosion proof "Ex d". It contains the safety barriers for the TCM. The inputs and outputs of the TCE are not power limited and must not be used to drive intrinsically safe circuits

The TCE 8***-wall mounted-****-Ex can be located inside and outside the hazardous area.

WARNING!

Never open any cover of the transmitters in hazardous locations with any supply or I/O circuits alive!

3.3.3. Connecting TCE and TCM

With the remote version the TCE and TCM must be connected before making the other electrical installations. If no TCM is connected to the TCE, the TCE will only show an error message after power on.

For connecting TCE and TCM, only the supplied special cable must be used. For best accuracy the maximum cable length is limited to 30 m.

NOTE:

Using different cables or any kind of extension will lead to a degradation of accuracy and stability.

Connecting the cable to the TCM

Open the junction box of the TCM.

Feed the cable from the TCE into the cable gland of the TCM and connect the single wires according to Tab. 2.

Adjust the position of the cable in the cable glands and close the cable gland.

| Terminal | Signal | Color Mark USA | Color Mark (rest of the world) | |
|----------|------------|----------------|--------------------------------|--------------------|
| | | | ≤150 ° C [302 ° F] | >150 ° C [302 ° F] |
| 1 | Driver + | Red | Gray | Gray/1 |
| 2 | Driver - | Black w/ Red | Pink | Gray/2 |
| 3 | Sensor A + | Blue | Blue | Gray/3 |
| 4 | Sensor A - | Black w/ Blue | Red | Gray/4 |
| 5 | Sensor B + | Green | White | Gray/5 |
| 6 | Sensor B - | Black w/ Green | Brown | Gray/6 |
| 7 | Pt1000 + | White | Green | Gray/7 |
| 8 | Pt1000 - | Black w/ White | Yellow | Gray/8 |

Tab. 2: Connections TCM **** (remote version)



Close the top cover of the junction box and fix it with the screw.

Connecting the cable to the TCE 8***-S-*

Connect the D-SUB connector of the cable to the connector “sensor” on the back side of the housing.

Fasten the fixing screws of the D-SUB connector properly.

3.3.4. Electrical Installation of the Wall Mount Transmitter Version

Connect the TCM to the TCE (see chapter 3.3.3, remote version only).

Open the safety screw at the display cover of the TCE with the provided Allen key.

Remove the display cover of the TCE by turning it counter clockwise.

Pull out the display.

Prepare the cable for installation:

- Separate the single wires for about 12 cm [4½ inches]
- Strip the end and cover it with a cable end sleeve
- Connect an about 7 cm [2½ inches] long stranded wire to the shield

Feed the cable through the cable gland.

Connect the shield to the PE screw.

NOTE:

In bigger installations a separate PE connection with a high cross section ($> 1.5 \text{ mm}^2$) is recommended for avoiding high equalizing currents in the shield.

Connect the individual conductors to the cage clamp terminals as required.

Push a small screwdriver into the upper (smaller) opening of the terminal, feed the cable into the bigger opening and pull out the screwdriver.

For the right connections refer to chapter 2.3 and chapter 3.3.6 to 3.3.8.

Adjust the position of the cable in the cable gland in that way that the single conductors remain short but free of tension and fix the cable in the cable gland.

Put in the display again. The display can be positioned in four different orientations, separated by 90°.

Perform – if necessary – a function test and make the necessary settings (in non Ex area only, see chapter 4.5).

Close the display cover and tighten properly the cable glands before applying the power..

Fasten the safety screw if necessary.

WARNING!

The Ex d protection of the housing is void, if any of the cable glands is not closed properly!

NOTE:

The supply terminals and the digital I/O terminals are rated for $U_M = 250 \text{ V}$ whereas the analog input and output and the interface terminals are rated for $U_M = 30 \text{ V DC}$.

WARNING! (FOR HAZLOC CSA INSTALLATION)**Unsuitable cables, cable glands and/or plugs**

Risk of explosion in hazardous areas.

Use only cable glands/plugs that comply with the requirements for the relevant type of protection. Replace the cable gland for the supply and I/O-cables by a CSA or UL certified seal fitting within 18" from the housing. Tighten the cable glands in accordance with the torques specified in "Technical Data TCE 8000/8100 Transmitter" (chapter 7.3.5).

Close unused cable inlets for the electrical connections.

When replacing cable glands use only cable glands of the same type.

After installation check that the cables are seated firmly.

3.3.5. Electrical Installation of the Panel Mount Version

Connect the TCM to the TCE (see chapter 3.3.3)

Prepare the cable for installation:

- Separate the single wires as required
- Strip the end and cover it with a cable end sleeve
- Connect an about 7 cm [2¾ inches] long stranded wire to the shield
- Connect the shield to the PE screw.

NOTE:

In bigger installations a separate PE connection with a high cross section ($> 1.5 \text{ mm}^2$) is recommended for avoiding high equalizing currents in the shield.

Connect the individual conductors to the cage clamp terminals as required.

Push a small screwdriver into the upper (smaller) opening of the terminal, feed the cable into the bigger opening and pull out the screwdriver.

For the right connections refer to chapter 2.3 and chapter 3.3.6 to 3.3.8.

Perform – if necessary – a function test and make the necessary settings (see chapter 4.5).

3.3.6. Power Supply and Grounding

3.3.6.1. 24 V DC Power Supply

The TCE requires a regulated power supply of 24 V DC.

The power supply input of the TCE is protected by a fuse. As a protection against fire in case of a short in the supply cable, the output of the power supply must be equipped with a fuse with a rating not higher than the current carrying capacity of the cable used.

For connecting the TCE use shielded cables. If several cables are used, each cable should be shielded properly.

For operation in hazardous areas a good connection of PE of PE is mandatory. The cross section of the PE cable should be at least equivalent to the cross section of the supply cable or to 1 mm^2 , whichever is higher.

Connect the ground of your power supply to terminal 51 and the 24 V DC to terminal 50 (see Fig. 20).

WARNING!

Applying 250 V AC to the DC supply terminals (50, 51) will not affect the Ex safety of the TCE or TCM, but will damage the supply circuit of the TCE!

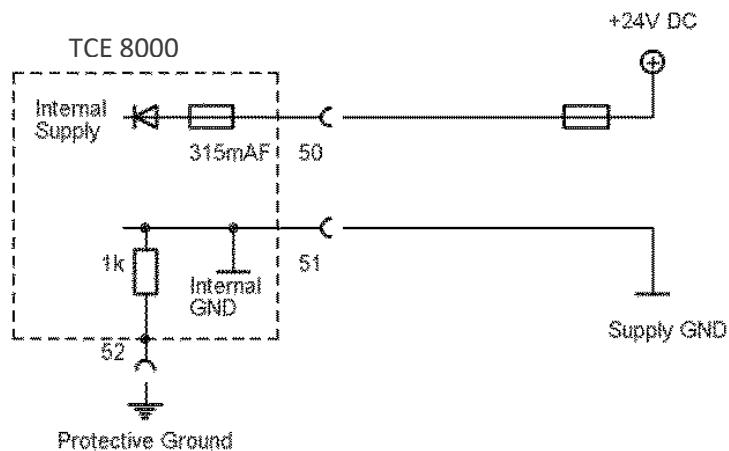


Fig. 20: Wiring diagram for power connections, DC operation

| Terminal | Description |
|----------|--|
| 50 | Positive supply voltage, 24 V DC, referred to pin 51 |
| 51 | Negative supply voltage |
| 52 | Protective ground |

The ground terminals 8 and 51 are internally connected together.

Ground and protective ground are internally connected via a 1 kΩ resistor. The resistor will thermally withstand a potential difference of up to 30 V between PE and GND but for proper operation this difference should be limited to 5 V.

3.3.6.2. 100...240 V AC Mains Supply

The AC version of the TCE requires a nominal power supply of 100...240 V AC and operates over a range of 90 ... 264 V AC.

The power supply input of the TCE is protected by a 1 A slow blow fuse. As a protection against fire in case of a short in the supply cable, the output of the power supply must be equipped with a fuse with a rating not higher than the current carrying capacity of the cable used.

For the mains powered TCE a good connection of PE is mandatory. The cross section of the PE cable should be at least equivalent to the cross section of the supply cable or to 1 mm², whichever is higher.

3.3.6.3. Finishing the transmitter connection

Connect the supply to terminal 91 (neutral) and 90 (phase) (see Fig. 21).

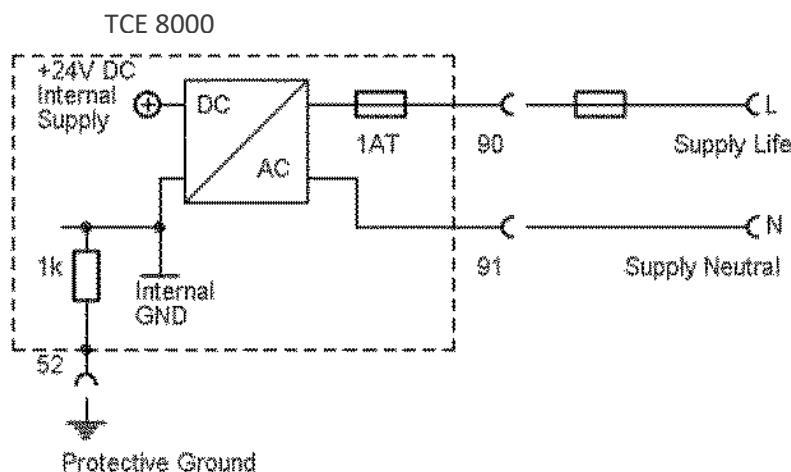


Fig. 21: Wiring diagram for power connections, AC operation

| Terminal | Description |
|----------|---------------------------------|
| 90 | Mains phase, referred to pin 91 |
| 91 | Mains neutral |
| 52 | Protective ground |

The ground terminal 8 is not connected to terminal 91.

3.3.6.4. DC and AC supply

The TCE 8***-S-*B** can be connected to a 24 V DC and a mains supply simultaneously. The unit will operate properly as long as one of the two supplies is present.

3.3.7. Control Inputs and Outputs

The digital I/O terminals are designed for a rated voltage of 250 V AC.

WARNING!

Applying 250 V AC to the digital I/O terminals (5, 6, 7, 8) will not affect the Ex safety of the TCE or TCM, but will damage the I/O board of the TCE!

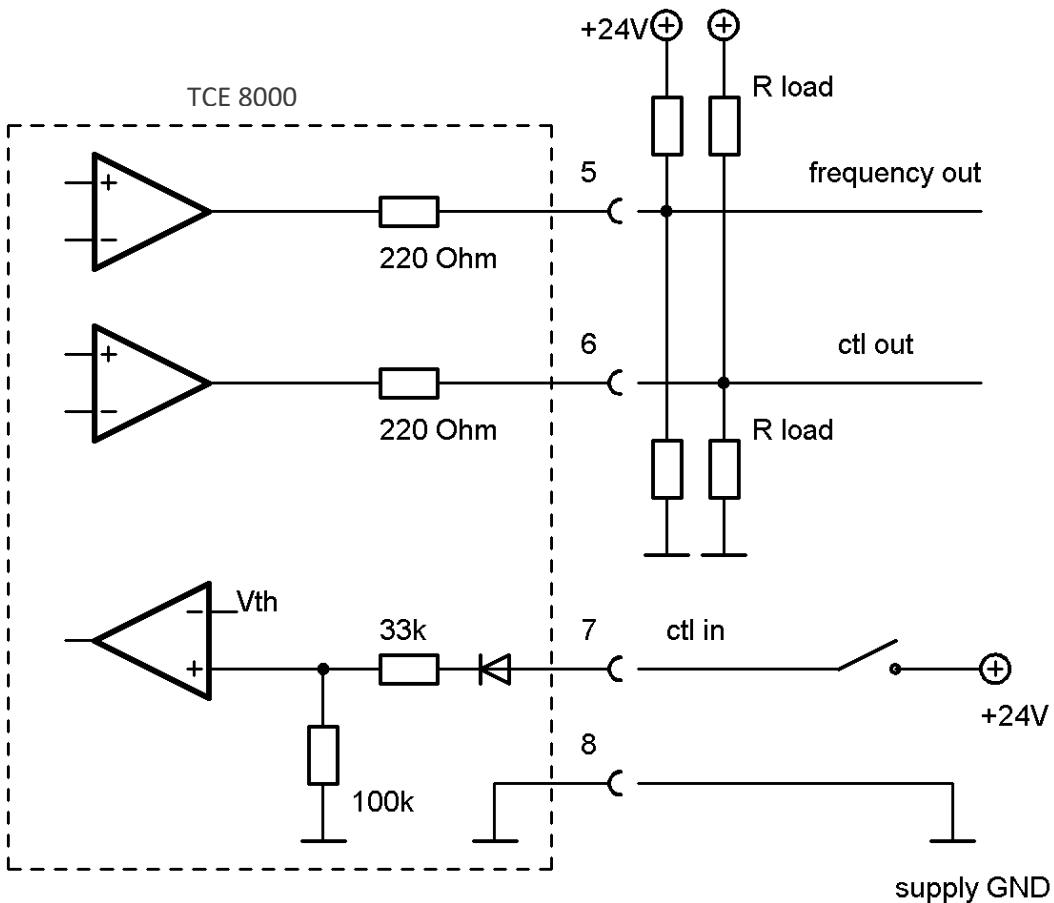


Fig. 22: Wiring diagram for digital I/O connections

| Terminal | Description |
|----------|---|
| 5 | Frequency output, active, referred to pin 8 |
| 6 | Status output, active, referred to pin 8 |
| 7 | Control input, active "HIGH", referred to pin 8 |
| 8 | Ground potential for digital I/O- pins. |

The frequency and control outputs are active push-pull outputs with an output resistance of 220Ω . They can be loaded to the positive supply or to ground. For a high output swing the load resistors R_{load} should not be lower than $1 \text{ k}\Omega$.

In case of a load resistor to ground the output voltages are:

$$V_{high} = V_{supply} * \frac{R_{load}}{220 \Omega + R_{load}}$$

$$V_{low} < 1 \text{ V}$$

In case of a load resistor to the positive supply the output voltages are:

$$V_{high} > V_{supply} - 1 \text{ V}$$

$$V_{low} = V_{supply} - V_{supply} * \frac{R_{load}}{220 \Omega + R_{load}}$$

The control input requires a high voltage of minimum 6.5 V and a minimum input current of 0.1 mA.

The ground terminals 8 and 51 are internally connected together.

Ground and protective ground are internally connected via a 1 kΩ resistor. The resistor will thermally withstand a potential difference of up to 30 V between PE and GND but for proper operation this difference should be limited to 5 V.

3.3.8. Analog Outputs

The TCE 8000 provides two independent passive 4 ... 20 mA current loops CURRENT 1 and CURRENT 2.

The current loops are isolated from each other and from the power supply.

For operation an external supply of 8 ... 30 V DC (nominal 24 V DC) is required.

The minimum voltage between terminal 1 and 2 or 3 and 4 respectively is 8 V.

The minimum load resistance is 0 Ω, the maximum is determined by the supply voltage.

At a given supply voltage the maximum load resistance can be calculated as:

$$R_{load} (max) = \frac{V_{supply} - 8 V}{22 mA}$$

For +24 V DC minus 10 % supply this gives a maximum value of 620 Ω.

With a given load resistance, the minimum supply voltage can be calculated as:

$$V_{supply} (min) = 8 V + R_{load} * 22 mA$$

WARNING!

Applying more than 30 V to any of the inputs or outputs will damage the TCE and destroy the protection of the TCM!

If more than 30 V have been applied to any of the analog output pins, the unit must be returned to KEM/AWL for repair as the safety barrier might be destroyed!

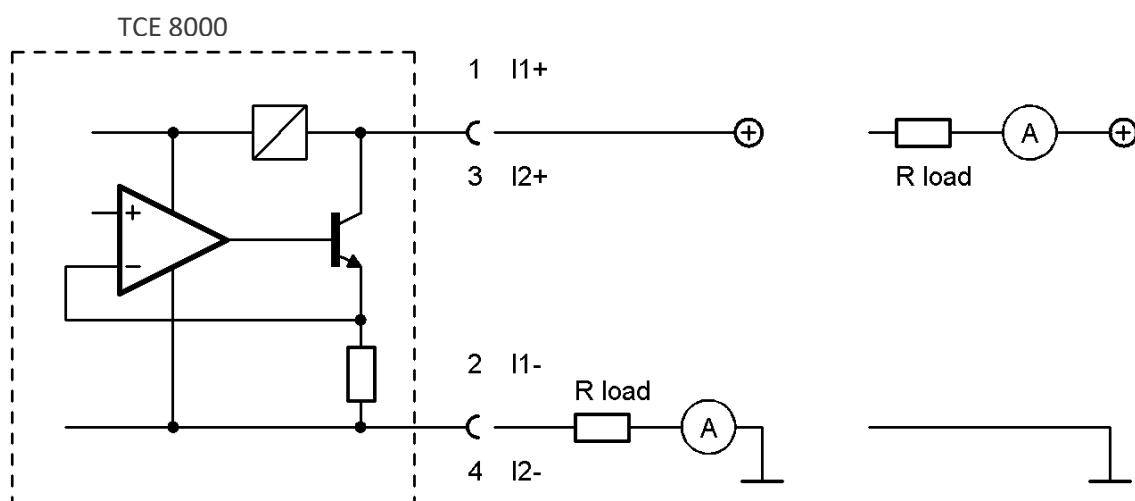


Fig. 23: Wiring diagram for 4 ... 20 mA current loop



| Terminal | Description |
|----------|---|
| 1 | Positive terminal of the passive 4 ... 20 mA loop 1 |
| 2 | Negative terminal of the passive 4 ... 20 mA loop 1 |
| 3 | Positive terminal of the passive 4 ... 20 mA loop 2 |
| 4 | Negative terminal of the passive 4 ... 20 mA loop 2 |

As the terminals are floating, the load resistor and the current meter can be placed in the positive or in the negative supply rail.

Connect the shield of the cables to protective ground (terminal 52).

3.3.9. Analog Input

The TCE 8000 with "PRESSURE COMPENSATION" option provides one passive 4 ... 20 mA output CURRENT 2 and one active 4 ... 20 mA current input CURRENT 1.

The current input is designed to drive a 2-wire passive 4 ... 20 mA pressure sensor. It provides a minimum driving voltage of 16 V.

The negative terminal (2) is internally connected to GND (non Ex version) or to PE (Ex version).

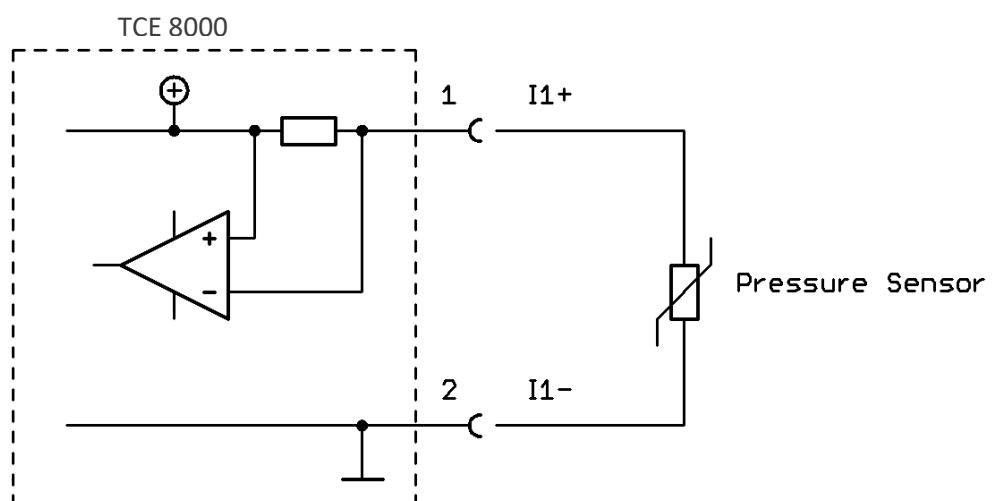


Fig. 24: Wiring diagram for 4 ... 20 mA current input

| Terminal | Description |
|----------|---|
| 1 | Positive terminal for a passive 4 ... 20 mA pressure sensor |
| 2 | Negative terminal for a passive 4 ... 20 mA pressure sensor |

Connect the shield of the cables to protective ground (terminal 52).

WARNING!

The analog input is not short-circuit proof. Load currents above 35 mA (permanent load) or above 50 mA (short-time load) can cause damages.

3.3.10. Connecting the Relay

Optionally the panel mount versions of the TCE 8000 series can be equipped with a relay output. The relay is a SPDT type with an nc (normally closed) and an no (normally open) contact.

| Terminal | Description |
|----------|-------------------------------|
| 40 | Relay normally open contact |
| 41 | Relay common |
| 42 | Relay normally closed contact |

The relay is specified for 125 V AC maximum.



4. Manual Operation

4.1. Power On Sequence and Principles of Manual Control

The power up sequence gives the following information, each for about two seconds:

CORIOLIS

TRICOR

TCE 8000

SENSOR TYPE

TCM 028K

Here appears the sensor type. Currently TCM 0325 (max. 325 kg/h) to TCM 230K (max. 230 t/h).

SW MAIN

Rev.: V3.40

This indicates the SW version of the main processor.

SW DISPLAY

Rev.: V3.40

This indicates the SW version of the display processor.

READY

If changes to the settings were made before the last power down and not saved to the backup EEPROM, the following message appears:

*** WARNING ***

NO ACTUAL RAM BACKUP

SEE MANUAL

OK

If no pushbutton is pressed the warning will disappear automatically after 10 seconds.

The absence of valid backup data has no influence on the reliability of operation of the meter. The backup is just used to restore the last operation setting in case important parameters of the TCE have misadjusted

For further information refer to chapter 4.5.9.

Now the TCE 8000 switches to the measuring mode, displaying the default screen:



The green LED "OK" flashes with a one second period. In case of an error the red LED "ERR" flashes.

In manual control the TCE is menu driven and provides two operational modes, the "Measuring Mode" and the "Control Mode".

In the measuring mode the display shows the preselected measured values and all four pushbuttons have the function printed on them. The switch over between the different display views can be made at any time, by pressing the "Display" button, without influencing neither the measurement nor the digital or analog outputs.

In the control mode the three pushbuttons below the display have varying functions. The actual function is indicated in the display, just above the pushbutton.

In the control menu all necessary settings can be made.

The control menu contains the submenus "ZERO OFFSET", "DISPLAY", "SETUP", "I/O-TEST", "SERVICE" and "FACTORY".

For protecting the TRICOR CLASSIC Mass Flow Meter against unintentional changes by unauthorized personnel, the menus "ZERO OFFSET", "SETUP" and "I/O-TEST" are protected by a user password, the menu "SERVICE" by a service password and the menu "FACTORY" by a factory password.

Additionally, a global access code can be set that locks the TRICOR CLASSIC Mass Flow Meter completely.

For the description of the control menu see chapter 4.5.

4.1.1. Using the Magnet

The explosion-proof variants with the blue Ex d housings provide a magnet to be able to operate the pushbuttons without opening the display cover.

In hazardous, wet and dusty areas the display cover must not be opened to operate the pushbuttons.

Beside every pushbutton there is a hall sensor which can be operated via the magnet attached to the housing.

For operating the pushbuttons hold the magnet to the glass.



The best positions for operating the keys are:

| Pushbutton | Position |
|------------|----------|
|------------|----------|

| | |
|---------|------------------------------------|
| P | left upper edge of the yellow area |
| Reset | lower edge of the yellow area |
| Display | lower edge of the yellow area |
| Info | lower edge of the yellow area |



4.2. Setup Guidelines

Ex factory the TRICOR CLASSIC Mass Flow Meters come with a setup optimized for normal applications. In more than 90 % of the applications no further optimization except a zero offset adjustment is required.

The different possibilities for optimizing the settings are described below.

4.2.1. Meter Mode

A Coriolis Mass Flow Meter measures the mass flow and the density and can calculate the volume flow.

For avoiding strange effects with the total values when changing the engineering units, the TCE 8000 can be set up as a Mass Flow Meter, a Volume Flow Meter, a Gas Flow Meter or a Net Oil Computer.

When set up as Mass Flow Meter, only mass flow engineering units can be selected, when set up as Volume Flow Meter or Net Oil Computer, only volume flow engineering units can be selected and when set up as Gas Flow Meter, only standard volume flow engineering units can be selected

For changing the meter mode refer to chapter 4.5.6.1. For the detailed description of the operating modes „REF .VOLUME“ und „NET OIL“ please refer to the TRICOR CLASSIC Net Oil Computer Addendum, e.g. on the TRICOR website: www.tricorflow.com/manuals/

4.2.2. Offset Adjustment

In contrast to a positive displacement meter, a Coriolis Mass Flow Meter does not have a “natural” zero. At no flow the measured time shift is nearly zero, but not exactly. The offset adjustment determines this offset and corrects the measured value correspondingly.

As the offset depends slightly upon the temperature, the density of the medium and the operating pressure, it is strongly recommended to make the offset procedure under working conditions, i.e. with the medium to be measured and at operating pressure and temperature.

To execute an offset adjustment, please refer to chapter 4.3.5 and 4.5.3.

4.2.3. Flow Filter

The raw data of a Mass Flow Meter is relatively noisy. To get a stable reading a filtering of the calculated flow is required.

The filters in the TCE 8000 are set by means of the time constant t . The time constant is the time the output needs, after a jump from a value x to 0, to go to $x/e = x/2.72$. A higher time constant means more stable reading, but also a slower reaction to changing flows.

A rough relation between the time and the filtered flow value after a jump is:

| Elapsed time | Remaining Error (% of the step) |
|--------------|------------------------------------|
| $1 * t$ | 30 |
| $2 * t$ | 10 |
| $3 * t$ | 3 |
| $4 * t$ | 1 |

A linear filter as it is realized in the TCE 8000 electronics just delays the flow reading and consequently the “TOTAL” value. Independent of the slope (fast or slow) of the rising and falling flow, the error of the internally calculated TOTAL and at the frequency output are canceled out, if the flow rises from zero (or any other value) and later goes back to the starting value. For getting a correct “TOTAL” via the display or the frequency output, it is just necessary to wait long enough after the flow is switched off.

For best results the TCE 8000 electronics provides two filters.

The “FLOW FILTER” filters the mass flow before calculating the TOTAL or the frequency and current outputs. For normal applications a moderate filtering with $t = 1$ s is recommended.

The “DISPLAY FILTER” filters the flow display additionally to the “FLOW FILTER”. It does not affect any other parameter or any of the outputs. The default setting is $t = 1$ s.

If the flow is changing fast or sometimes makes a jump and the outputs have to react as fast as possible, set “FLOW FILTER” to $t < 1$ s. If nevertheless the flow display has to be stable for better readability, the “DISPLAY FILTER” can be increased.

For setting up the “FLOW FILTER” refer to chapter 4.5.7.1, for the “DISPLAY FILTER” to chapter 4.5.4.2.

4.2.4. CUT OFF

As mentioned above, a Mass Flow Meter has no natural zero and the raw data is noisy. Consequently, with no flow, a meter would indicate and give out continuously a small fluctuating flow.

The parameter “CUT OFF” is used to provide a clear zero. If the calculated and filtered flow is below “CUT OFF”, the meter indicates zero, the “TOTAL” values remain unchanged and the outputs show zero flow as well.

The value for “CUT OFF” must be above the noise floor in the given application and well below the minimum flow to be measured. As a good compromise the default value for “CUT OFF” is 0.3 % of the full scale range of the meter.

For setting “CUT OFF” please refer to chapter 4.5.6.3.

4.2.5. STEP RESPONSE

Sometimes it is necessary to react fast to a fast changing flow, but also to have a stable output, if the flow is (mostly) constant. This cannot be achieved by adjusting the flow filter.

The parameter “STEP RESPONSE” provides a fast reaction at fast changing flow, also the filter constant is high.

If the difference between the measured flow and the filtered flow is smaller than the “STEP RESPONSE” value, the flow filter remains active. If the difference is higher than step response, the filter is cleared and filled with the new value.

The recommended value for constant or slowly changing flow is 99 % (the default value). If the unit has to react to fast changing flow, the optimum value depends on the individual situation. For ON/OFF operation a value of half the ON flow is recommended.



If “STEP RESPONSE” is set too low, even small changes in flow or even the internal noise will activate the step response function and partially or all the time deactivate the filter, leading to noisy readings and noisy output signals.

For setting “STEP RESPONSE” refer to chapter 4.5.6.4.

4.2.6. Interaction of the Parameters

As each of the three parameters affects the calculation of the flow in a different way, a bad combination of different parameters can lead to systematical errors.

FLOW FILTER and CUT OFF

If the filter constant is set to a high value, the calculated flow is delayed compared to the actual flow. In ON/OFF operation this leads to the fact that it takes a long time until the calculated flow settles to the ON or OFF value. The “TOTAL” value remains correct if the TCM measures long enough after the flow got switched off. If “CUT OFF” is set to a high value, the meters stops measuring too early and consequently the calculated “TOTAL” is too low. Also the number of pulses at the frequency output is too low. The error is systematic.

NOTE:

In ON-OFF operation high values for the flow filter combined with high values for “CUT OFF” must be avoided! Jumps of the flow not going down to zero are not affected by “CUT OFF”.

FLOW FILTER and STEP RESPONSE

A linear filter just delays the flow reading and consequently the total but does not alter the final “TOTAL”.

If the “STEP RESPONSE” is activated, a nonlinear term is added to the filter. The indicated flow will follow more closely the total flow, but the remaining deviation depends on the values for the filter and for “STEP RESPONSE”, but also on the slope of the flow change and on the size of a step.

If the flow changes slowly or a jump is smaller than “STEP RESPONSE”, the function will not be activated and remains linear all the time, producing the normal delay.

If the flow changes fast and the step is higher than “STEP RESPONSE”, the filter will be made faster, the indicated flow follows more closely the actual flow and the delay will be smaller.

In ON/OFF operation with a fast rising and slowly falling flow a systematic positive error is to be expected. If the rising is slow and the falling fast, the error will be negative.

WARNING!

If “STEP RESPONSE” is used (e.g. for good reaction to fast changing flow), checking the accuracy for the given application is strongly recommended!

4.3. Measuring Mode

4.3.1. Function of the Pushbuttons

In the measuring mode all pushbuttons have a fixed function:

| | |
|---------|--|
| P | Opens the Control Menu if pressed for about 2 - 3 seconds |
| Reset | Resets the "BATCH" counter to zero, if the function "KEY RESET" is enabled |
| Display | Toggles the display between the preselected settings. |
| Info | Opens the info menu |

4.3.2. Display Selection

The TCE provides two presettable display views. Ex factory view 1 shows the flow and the "TOTAL" value, view 2 shows density and temperature.

In the "fixed mode" the display view selected by the user remains active until the other view is selected. For changing from one view to the other just press the pushbutton "Display".

In the "alternate mode" the TCM toggles between display view 1 and 2 every seven seconds. In this mode the pushbutton "Display" is without function.

For changing the content of the display views, please refer to chapter 4.5.4.

4.3.3. Display Resolution

The measured values can be displayed with 8 digits, including decimal point and sign. The most positive value therefore is "9999999." (7 digits), the most negative value is "-999999." (6 digits).

If the decimal point is set in that way that one or more decimal points are displayed and the value to be displayed exceeds the display range, the decimal point will be shifted to the right.

Example:

| | | |
|------------------------|------------|-------------|
| Decimal point setting: | x.xxx | x.xxx |
| Measured value: | 12345.6789 | -12345.6789 |
| DP setting changed to: | xx.xx | xxx.x |
| Displayed value: | 12345.67 | -12345.67 |

The new setting for the decimal point will remain, also if the measured value goes down again. It can only be reset to the original settings in the "DISPLAY" menu.

If the decimal point is at the most right position and the measured or calculated value is still too big for being displayed, the display shows "DISPLAY OVERFLOW". As soon as the measured value returns into the displayable range, the error message disappears and the display shows the value.

If the display shows "DISPLAY OVERFLOW", change the engineering units. If any "TOTAL" display shows "DISPLAY OVERFLOW", you can also reset the "TOTAL" values. (see chapter 4.5.6.10).

4.3.4. Resetting the Batch (TOTAL-) Value

For easy batching in local operation the TCE provides the possibility to reset the Batch value by pressing the pushbutton "Reset". For protecting the TRICOR CLASSIC Mass Flow Meter against unintentional resetting, this function can be disabled.

For changing the setting, please refer to chapter 4.5.6.5.



4.3.5. Event Logging

Starting with software version Mv3.40 and Dv3.40, all TRICOR CLASSIC mass flow meters include event logging that records events occurring at runtime with a timestamp and a unique code. These events can either be shown on the display or read/reset (erased) via Modbus. The use of event logging is explained below using the display as an example. For a description of access via Modbus, see the TRICOR CLASSIC Modbus manual (document: "Modbus (RTU) Manual": chapter 3.6).

There are three event classes:

- INFO: Information that a permissible event has occurred (successful initialisation for example).
- WARN: Warning that a generally permissible but possibly problematic event has occurred
- ERR:ON or ERR:OFF: Indicates that an error state has occurred (ERR:ON) or is no longer active (ERR:OFF)

4.3.5.1. Event codes

All events codes are listed below and their meanings are explained.

Error (ERR codes)

| Event Code | | Message on display | Meaning |
|------------|-------------|-----------------------|--|
| ERR: ON | ERR: OFF | | |
| 0 | 96 | INITIALIZATION FAILED | Device initialisation could not be completed successfully. |
| 1 | 97 | AMP. SENSOR A | The voltage amplitude induced from Sensor A is too high or too low. |
| 2 | 98 | AMP. SENSOR B | The voltage amplitude induced from Sensor B is too high or too low. |
| 3 | 99 | MEAS. DELAY OVER 250 | The measured time delay is above the specified allowable limit value |
| 5 | 101 | UNST. DRIVER CURRENT | Driver current is too unstable |
| 6 | 102 | PT1000 OUT OF RANGE | The value of the temperature sensor is too high or too low (often indicates a line break or short circuit) |
| 7 | 103 | TUBE FREQ. TOO LOW | The frequency of the oscillating tube is below the specified allowable limit value |
| 8 | 104 | TUBE FREQ. TOO HIGH | The frequency of the oscillating tube is above the specified allowable limit value |
| 9 | 105 | DRIVER CURRENT LOW | The driver current is below the specified allowable limit value |
| 10 | 106 | DRIVER CURRENT HIGH | The driver current is above the specified allowable limit value |
| 17 | 113 | MASS FLOW TOO HIGH | The mass flow is above the specified allowable limit value |
| 18 | 114 | MASS FLOW TOO LOW | The mass flow is below the specified allowable limit value |
| 19 | 115 | TEMPERATURE TOO HIGH | The temperature is above the specified allowable limit value |
| 20 | 116 | TEMPERATURE TOO LOW | The temperature is below the specified allowable limit value |

| | | | |
|----|-----|-------------------|---|
| 21 | 117 | DENSITY TOO HIGH | The density is above the specified allowable limit value |
| 22 | 118 | DENSITY TOO LOW | The density is below the specified allowable limit value |
| 23 | 119 | PRESSURE TOO HIGH | The pressure is above the specified allowable limit value |
| 24 | 120 | PRESSURE TOO LOW | The pressure is below the specified allowable limit value |

Tab. 3: List of errors (ERR Codes)

Warnings (WARN Codes)

| Event code WARN | Message on display | Meaning |
|--------------------|-----------------------|--|
| 192 | FACT. BACKUP MISSING | A factory backup has not been prepared yet |
| 193 | BACKUP NOT UP TO DATE | Settings have been changed but not yet saved in the backup |
| 194 | OFFSET IN PROGRESS | Zero point adjustment is currently in progress |
| 195 | GRAND TOTAL VOL OVFL | Overflow of the Grand Total on the display in modus: volume measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation |
| 196 | GRAND TOTAL MASS OVFL | Overflow of the Grand Total on the display in modus: mass measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation |
| 197 | BATCH TOTAL VOL OVFL | Overflow of the Batch Total on the display in modus: volume measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation |
| 198 | BATCH TOTAL MASS OVFL | Overflow of the Batch Total on the display in modus: mass measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation |
| 199 | FAIL. TOTAL VOL OVFL | Overflow of the Failure Total on the display in modus: volume measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation |
| 200 | FAIL. TOTAL MASS OVFL | Overflow of the Failure Total on the display in modus: mass measurement. After this overflow the representation of the total in the display will automatically switch to scientific (exponential) notation |
| 192 | FACT. BACKUP MISSING | A factory backup has not been prepared yet |
| 193 | BACKUP NOT UP TO DATE | Settings have been changed but not yet saved in the backup |
| 194 | OFFSET IN PROGRESS | Zero point adjustment is currently in progress |

Tab. 4: List of warnings (WARN Codes)



Information (INFO Codes)

| Event code INFO | Message on display | Meaning |
|---------------------------|-----------------------|--|
| 224 | FACT. BACKUP OK | A factory backup has been prepared |
| 225 | BACKUP IS UP TO DATE | All new settings have been saved in the backup |
| 226 | POWER ON SEQUENCE | The device has been powered up |
| 227 | INITIALIZATION PASSED | Device initialisation was completed successfully |

Tab. 5: List of information (INFO Codes)

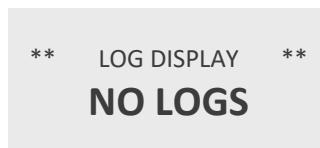
4.3.5.2. Info and event log menu

The TCE display has an info and event log menu for straightforward troubleshooting. The contents of this menu are not of interest for normal operation. It only contains information for trained personnel.

To open the menu, press the “Info” button for about three seconds. Then the event log menu (“LOG DISPLAY”) is displayed first. All recorded log entries are shown and can be reset (erased) here.

Display of log entries

“NO LOGS” is displayed if no events have been recorded or they have all been reset:



If events have been recorded, the most recent entry is always displayed first (the logged events are displayed in the order in which they occurred).

This is illustrated here with two log entries as an example:



Here the most recently recorded (most current) is an INFO event that is the second of a total of two existing log entries. It was recorded approximately 4.8 seconds after powering up the TCE and provides the information that initialisation of the TCE was completed successfully at that time (“INITIALIZATION PASSED”).

Resetting (erasing) event logs

Press the “Reset” button to reset (erase) the current log entry.

Provided the displayed event does not represent an active error state (“ERR:ON”), the following dialogue is displayed where you can confirm resetting the log entry by pressing the “Display” button or cancel by pressing the “Reset” button (attention: log entries cannot be restored once they have been reset):

```
** LOG DISPLAY **
LOG#: 2/2 INFO
CLEAR THIS LOG ENTRY?
YES           NO
```

If the displayed log entry is of the type “ERR:ON”, it cannot be reset as long as the corresponding error state remains active. In this case the following warning is shown on the display when the “Reset” button is pressed:

```
** LOG DISPLAY **
LOG#: 3/4 ERR:ON
LOG CANNOT BE CLEARED
ERROR IS STILL ACTIVE
```

If you want to reset all log entries at once, you can do so in the setup menu under the menu item “CLEAR LOGS” (see chapter 4.5.11).

Navigating between log entries

Press the “Display” button to show the previous event (log entry) in chronological order:

```
** LOG DISPLAY **
LOG#: 1/2 INFO
TIMESTAMP: 0,005s
POWER ON SEQUENCE
```

Press the “Info” button to navigate to the previous log entry. You can repeat this until you get to the last log entry.

Info menu

When the last log entry is displayed (for instance LOG#: 5/5 INFO), pressing the “Info” button again opens the Info menu that lists the following 7 internal device parameters:

| Code | Value |
|------|--|
| SA | Sensor voltage A in mV |
| SB | Sensor voltage B in mV |
| DR | Drive current in mA |
| PT | Resistance value of the temperature sensor in Ω |
| FRE | Oscillating frequency in Hz |
| ZP | Zero point offset in μ s |
| TSF | Filtered time shift in μ s |

Tab. 6: List of service parameters



Press “Info” again to get general information about the TCM:

| Code | Value |
|-------|--|
| TYPE: | Sensor type (TCM*) |
| SER.: | Serial number |
| SW1: | SW version main board |
| SW2: | SW version display |
| COMM: | Active interface: Modbus/baud rate/address HART®/address FF/address |
| CODE: | SW option code |

Tab. 7: List of TCM device info

By pressing “Info” you can toggle between those info views. To return to the normal operation screen, press “DISPLAY”.

4.3.6. Totalizer

On the display the following three totalizer can be shown:

- Batch Total
- Grand Total
- Failure Total

The maximum number of places that can be shown on the display is limited to 7 („1234567“).

If a totalizer exceeds this limit, the representation of the total on the display will automatically switch to scientific (exponential) notation.

For example, if a totalizer has the value „9999999“ kg and then get incremented by another one kilogram, the totalizer will now display: „1.0000E7“ kg.

Thus ensures that no totalizer can be resetted by an overflow in the lifecycle of the device.

4.4. Offset Adjustment

For best accuracy the TRICOR CLASSIC Mass Flow Meter needs an in situ offset adjustment. This calibration zeroes out the ambient effects and increases the measuring accuracy at low flow.

The offset adjustment must be carried out with the medium to be measured and at a temperature and pressure as close to the normal operation as possible.

Proceed as follows:

Operate the TCM for a while under normal operating conditions to make sure that the actual temperature of the TRICOR CLASSIC Mass Flow Meter equals the normal operating temperature.

Switch off the flow. For best results use a valve in front and one behind the TCM. If the valves are not close to the TCM and/or only one valve is used, wait long enough to be sure that there is no more flow through the TCM.

NOTE:

If there is a residual flow through the TCM or it is exposed to mechanical shocks during the offset adjustment procedure, the resulting value will be wrong.

Start the offset procedure as follows (see also chapter 4.5.3):

- Press “P” for about three seconds
- The display shows “ZERO OFFSET”
- Press “P”
- Change the indicated number with “UP” to “2207” and confirm with “P”
- Press “SLOW” (recommended) or “FAST”
- The display shows “MAKE ZERO” for 10 to 30 seconds and counts down to “0”
- Confirm with “Info”

Depending on the meter size and the density of the medium, the offset procedure takes about 10 -20 seconds (FAST) or 30...60 seconds (SLOW). During this procedure the red LED will flash.

For an automatic offset adjustment initiated by the central control unit, the control input can be configured as “Initiate offset”. In that case the TCE starts an offset procedure each time a high level is applied to the input.

To configure the input, please refer to chapter 4.5.8.4.



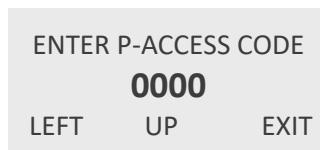
4.5. Control Mode

In the control mode the TCE 8000 can be adapted to the individual application. As unintentional changes of the settings might cause problems, some submenus are password protected. Additionally, using the "SERVICE" menu, a global access code can be set that locks the TRICOR CLASSIC Coriolis Mass Flow Meter completely.

To enter the control mode proceed as follows:

Press "P" for about three seconds

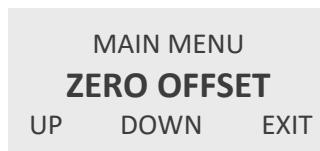
If a global access code is set the display shows



Change the indicated number with "LEFT" and "UP" to the defined code and confirm with "P".

If a wrong code is entered, the display shows "ERROR" for about two seconds and then returns to the measurement mode.

When the correct code is entered the display shows



With the keys "UP" and "DOWN" you can scroll through the main list.

Select the desired submenu and confirm with "P".

4.5.1. Function of the Pushbuttons

In the setup menu some pushbuttons have changing functions, indicated in the display above the pushbutton:

| | |
|-------------|--|
| P | Confirms the selection in a list or any kind of inputs |
| Reset | Performs the indicated function |
| Display | Performs the indicated function. |
| Info (Exit) | Performs the indicated function. In most cases exits the current menu point without altering the original value |

4.5.2. Submenus in the Main Menu

In the Main Menu the following submenus are addressable:

ZERO OFFSET:

Performing the automatic offset adjustment procedure.

This submenu is password protected.

DISPLAY:

Presetting the display.

Changes made in this submenu have no influence on the general function as well on the accuracy of the TCM.

SETUP:

Adjusting the TCE 8000 and configuring the inputs and outputs.

This submenu is password protected.

I/O-TEST:

Setting the outputs to defined values and displaying the actual status of the control inputs for testing the electrical connections.

This submenu is password protected.

SERVICE:

Calibrating the TCE 8000 with connected TCM.

This submenu is password protected.

FACTORY:

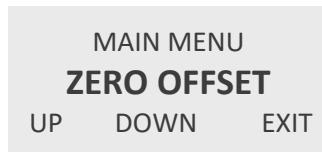
Service settings for TCE 8000 with connected TCM.

This submenu is password protected.



4.5.3. ZERO OFFSET Menu

Select in the main menu



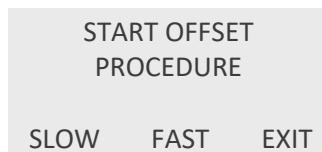
Press "P". The display shows



Change the indicated number with "LEFT" and "UP" to "2207" and confirm with "P".

If a wrong code is entered, the display shows "ERROR" for about two seconds and then asks for a new input.

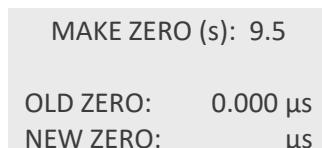
When the correct code is entered the display shows



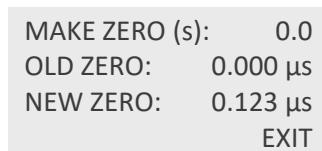
Press "SLOW" or "FAST" to start the procedure or skip with "EXIT".

A "SLOW" procedure lasts 30 s to 60 s, a "FAST" procedure 10 s to 20 s.

The display shows



The time counter counts down to zero. The display shows e.g.



Press "EXIT" to return to the measuring mode.

4.5.4. DISPLAY Menu

Select in the main menu



Press "P". The display shows



The following submenus are available:

MASS TOTAL:

Setting the mass TOTAL and Batch units and the mass TOTAL and Batch decimal point.

MASS FLOW:

Setting the mass flow units, the mass flow decimal point and a flow filter for the display.

VOL. TOTAL:

Setting the volume TOTAL and Batch units and the volume TOTAL and Batch decimal point.

VOL. FLOW:

Setting the volume flow units, the volume flow decimal point and a flow filter for the display.

DENSITY:

Setting the density units and the density decimal point.

TEMPERATURE:

Setting the temperature units and the temperature decimal point.

PRESSURE:

Setting the pressure units (only available with option "PRESSURE COMPENSATION").

DISP MODE:

Setting the content of the two display views and the display mode (static or alternating).

4.5.4.1. DISPLAY - MASS TOTAL Menu

In the submenu "MASS TOTAL" the mass "TOTAL" and Batch engineering units and the flow decimal point can be set.



Use the keys "UP" and "DOWN" to select the desired submenu and confirm with "P" or skip with "EXIT".



Manual Operation

The following submenus are available:

TOTAL UNITS:

Setting the “TOTAL” units.

TOTAL DP:

Setting the “TOTAL” decimal point.

TOTAL UNITS



The following units can be selected:

| Mass-Unit | Description |
|-----------|-------------|
| GRAM | gram |
| KG | kilogram |
| POUNDS | pound |
| OUNCES | dry ounce |
| TONS | metric ton |
| STONES | stone |
| MT | metric ton |

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

TOTAL DP



Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.2. DISPLAY - MASS FLOW Menu

In the submenu “MASS FLOW” the mass flow engineering unit, the flow decimal point and the flow filter for the display can be set.



Use the keys “UP” and “DOWN” to select the submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

FLOW UNITS:

Setting the flow units.

FLOW DP:

Setting the flow decimal point.

DISP FILTER:

Setting the display filter.

FLOW UNITS



The following units (mass per time) can be selected:

Time-Unit Description

| | |
|-----|--------|
| S | second |
| MIN | minute |
| H | hour |
| D | day |

Mass-Unit Description

| | |
|----|------------|
| G | gram |
| KG | kilogram |
| LB | pound |
| OZ | dry ounce |
| T | metric ton |
| ST | stone |
| MT | metric ton |

Use the keys "UP" and "DOWN" to select the engineering unit and confirm with "P" or skip with "EXIT".

FLOW DP



Use the key "LEFT" to select the desired decimal point position and confirm with "P" or skip with "EXIT".

DISP FILTER



The time constant t is the time the displayed value needs after a jump from a value x to 0 to go to $x/e = x/2.72$.

NOTE:

The display filter only filters the value in the display to provide a more stable reading. It has no influence on the outputs. It is only valid for the mass or volume flow display view!

As the display filter is additional to the global filter, the display can never react faster than the outputs.

Use the keys "RIGHT" and "UP" to select the desired time constant and confirm with "P" or skip with "EXIT".



Manual Operation

4.5.4.3. DISPLAY - VOL. TOTAL Menu

In the submenu “VOL.TOTAL” the volume “TOTAL” and Batch engineering units and the flow decimal point can be set.



Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

TOTAL UNITS:

Setting the “TOTAL” units.

TOTAL DP:

Setting the “TOTAL” decimal point.

TOTAL UNITS



The following units can be selected:

| Volume-Unit | Standard volume | Description |
|-----------------|------------------|---|
| | | (if gas measuring mode activated see chapter 4.5.6.1) |
| cm ³ | Ncm ³ | (Norm) Cubic Centimeter |
| LITER | NL | (Norm) Liter |
| GAL | SGAL | (Standard) US Gallon |
| BBL | STB | (Standard) US Barrel |
| LOZ | SLOZ | (Standard) Liquid Ounce |
| IGAL | SIGL | British (Standard) Gallon |
| IBBL | SIBL | British (Standard) Barrel |
| m ³ | Nm ³ | Cubic Meter |
| kM ³ | kNm ³ | (Norm) 1000 Cubic Meter |
| hL | hNL | (Norm) Hectoliter |
| kL | kNL | (Norm) Kiloliter |
| ML | MNL | (Norm) Megaliter |
| CF | SCF | Cubic Foot |
| MCF | MSCF | (Standard) 1,000 Cubic Feet |
| MMCF | MMSCF | 1,000,000 (Standard) Cubic Feet |

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

TOTAL DP



Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.4. DISPLAY - VOL. FLOW Menu

In the submenu “VOL. FLOW” the volume flow engineering unit, the flow decimal point and the flow filter for the display can be set.



Use the keys “UP” and “DOWN” to select the submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

FLOW UNITS:

Setting the flow units.

FLOW DP:

Setting the flow decimal point.

DISP FILTER:

Setting the display filter.

FLOW UNITS



The following units (mass per time) can be selected:

Time-Unit **Description**

| | |
|-----|--------|
| S | second |
| MIN | minute |
| H | hour |
| D | day |

Volume-Unit **Standard volume** **Description**

| | | |
|---|------------------|-----------------------------|
| (if gas measuring mode activated see chapter 4.5.6.1) | | |
| cm ³ | Ncm ³ | (Norm) Cubic Centimeter |
| LITER | NL | (Norm) Liter |
| GAL | SGAL | (Standard) US Gallon |
| BBL | STB | (Standard) US Barrel |
| LOZ | SLOZ | (Standard) Liquid Ounce |
| IGAL | SIGL | British (Standard) Gallon |
| IBBL | SIBL | British (Standard) Barrel |
| m ³ | Nm ³ | Cubic Meter |
| kM ³ | kNm ³ | (Norm) 1000 Cubic Meter |
| hL | hNL | (Norm) Hectoliter |
| kL | kNL | (Norm) Kiloliter |
| ML | MNL | (Norm) Megaliter |
| CF | SCF | Cubic Foot |
| MCF | MSCF | (Standard) 1,000 Cubic Feet |

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.



Manual Operation

FLOW DP



Use the key "LEFT" to select the desired decimal point position and confirm with "P" or skip with "EXIT".

DISP FILTER



The time constant t is the time the displayed value needs after a jump from a value x to 0 to go to $x/e = x/2.72$.

NOTE:

The display filter only filters the value in the display to provide a more stable reading. It has no influence on the outputs. It is only valid for the mass or volume flow display view!

As the display filter is additional to the global filter, the display can never react faster than the outputs.

Use the keys "RIGHT" and "UP" to select the desired time constant and confirm with "P" or skip with "EXIT".

4.5.4.5. DISPLAY - DENSITY Menu

In the submenu "DENSITY" the density engineering unit and the decimal point for the display can be set.



Use the keys "UP" and "DOWN" to select the submenu and confirm with "P" or skip with "EXIT".

The following submenus are available:

DENS UNITS:

Setting the density units.

DENS DP:

Setting the density decimal point.

DENS UNITS



The following engineering units (mass per volume) can be selected:

| Unit | Description |
|--------------------|---------------------------|
| G/cm ³ | Gram per Cubic Centimeter |
| G/L | Gram per Liter |
| KG/m ³ | Kilogram per Cubic Meter |
| KG/L | Kilogram per Liter |
| LB/FT ³ | Pounds per Cubic Feet |
| LB/GAL | Pounds per Gallon |
| BRIX | Brix |

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

As BRIX specifies the sugar content in water, it is only calculated for densities between 990 and 1,130 g/l. If the measured density is outside that range, the display shows “INVALID”.

DENS DP



Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.6. DISPLAY - TEMPERATURE Menu

In the submenu “TEMPERATURE” the temperature unit and the temperature decimal point for the display can be set.



Use the keys “UP” and “DOWN” to select the submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

TEMP UNITS:

Setting the temperature units.

TEMP DP:

Setting the temperature decimal point.

TEMP UNITS





Manual Operation

The following units can be selected:

| Unit | Description |
|--------|-------------|
| °C | Centigrade |
| °F | Fahrenheit |
| KELVIN | Kelvin |

Use the keys “UP” and “DOWN” to select the engineering unit and confirm with “P” or skip with “EXIT”.

TEMP DP



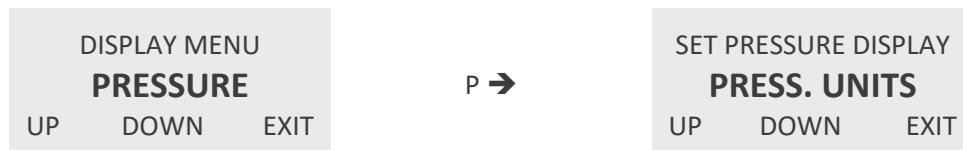
Use the key “LEFT” to select the desired decimal point position and confirm with “P” or skip with “EXIT”.

4.5.4.7. DISPLAY - PRESSURE Menu

In the submenu “PRESSURE” the pressure engineering unit and the decimal point can be set.

NOTE:

This menu is only visible with the option “PRESSURE COMPENSATION”.



Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

The following submenus are available:

PRESS. UNITS:

Setting the pressure units.

PRESSURE DP:

Setting the pressure decimal point.

PRESS. UNITS



The following units can be selected:

| Unit | Description |
|------|---------------------------------|
| KPA | kilopascal |
| MPA | megapascal or N/mm ² |
| PSI | pound per square inch |
| BAR | bar |

Use the keys "UP" and "DOWN" to select the engineering unit and confirm with "P" or skip with "EXIT".

PRESS DP



Use the key "LEFT" to select the desired decimal point position and confirm with "P" or skip with "EXIT".

4.5.4.8. DISPLAY - DISPLAY MODE Menu

In the submenu "DISP MODE" the display mode can be set.



Use the keys "UP" and "DOWN" to select the desired submenu and confirm with "P" or skip with "EXIT".

The following submenus are available:

DISPLAY 1:

Setting the content of display view 1.

DISPLAY 2:

Setting the content of display view 2.

BACKLIGHT:

Switching on and off the backlight.

TIME MODE:

Setting fixed or alternating display.

DISPLAY 1



Use the keys "UP" and "DOWN" to select dual line or single line and confirm with "P" or skip with "EXIT".

The display shows:





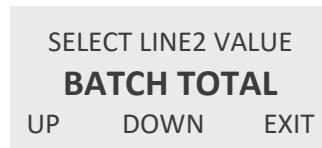
Manual Operation

The following values can be selected:

| Value | Description |
|-------------|---|
| RATE | Actual flow |
| BATCH TOTAL | Batch count |
| TEMPERATURE | Temperature |
| GRAND TOTAL | TOTAL count |
| FAIL. TOTAL | Failure total count |
| F-OUT | Actual frequency at the frequency output |
| mA-OUT I1 | Actual current at the analog output 1 |
| mA-OUT I2 | Actual current at the analog output 2 |
| mA-IN | Actual current at the analog input (optional) |
| PRESS ext. | Pressure value measured from the actual analog input current (optional) |
| comp PRESS | Pressure value used for compensation (optional) |

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

If “DUAL LINE” was selected, the display shows



Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The TCM returns to the “DISPLAY MODE” menu.

DISPLAY 2

See DISPLAY 1

BACKLIGHT



Use the keys “UP” and “DOWN” to switch on or off the backlight and confirm with “P” or skip with “EXIT”.

TIME MODE



In the “FIXED” mode the display shows constantly the defined display view 1 or 2. With the pushbutton “DISPLAY” it is possible to switch over between display view 1 or 2.

In the “ALTERNATE” mode the display switches over every 7 seconds between display view 1 and 2. The pushbutton “DISPLAY” is deactivated.

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

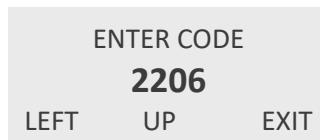
4.5.5. SETUP Menu

In the “SETUP” menu all settings can be made to adapt the meter to the individual requirements.

Select in the main menu



Press “P”. The display shows



Change the indicated number with “LEFT” and “UP” to “2207” and confirm with “P”. If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows



The following submenus are available:

PARAMETER:

| | |
|--------------|--|
| METER MODE | Selection between Mass Flow Meter and Volume Flow Meter |
| CUT OFF | Setting the flow CUT OFF value |
| STEP RESP | Set Step Response (option) |
| RESET KEY | Enable/disable the key “Reset” |
| FLOW-DIREC | Setting up the TCM for reverse flow |
| K-FACTOR | Factor for fine scaling the metric variable of the meter |
| FAULT TIME | Setting the error response time |
| PRESS. COMP. | Enable/disable the “PRESSURE COMPENSATION” (option) |
| TOTAL COUNT | Setting up the mode of operation “TOTAL counter” |
| LANGUAGE | Selecting the display language |

FILTER:

| | |
|------|--|
| FLOW | Setting the flow filter time constant |
| DENS | Setting the density filter time constant |

IN/OUTPUTS:

| | |
|-----------|---|
| FREQ OUT | Configuring the frequency output |
| CTRL OUT | Configuring the control output |
| mA OUT | Configuring the analog output (4 ... 20 mA) |
| CTRL IN | Configuring the control input |
| mA-IN I1 | Configuring the analog input (option) |
| INTERFACE | Configuring the interface |

DATA CONFIG:

| | |
|-------------|---|
| SAVE DATA | Saving the actual settings as backup |
| RECALL DATA | Recalling the last settings from the backup |

RESET TOTAL:

| | |
|-------------|---|
| RESET TOTAL | Resets the TOTAL and the FAIL. TOTAL count to zero. |
|-------------|---|



CLEAR LOGS:

CLEAR LOGS Acknowledge (delete) all logged events in the Log memory.

Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

4.5.6. SETUP - PARAMETER Menu

In the submenu “SETUP - PARAMETER” all user settable internal parameter can be set for adjusting the TCM for a given application.



Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

4.5.6.1. METER MODE Menu

In the submenu “METER MODE” the meter mode (“MASS METER” for Mass Flow Meter, “VOLUME METER” for Volume Flow Meter, „REF.VOLUME“ for gas measuring mode under reference conditions or „NET OIL“ for Net Oil Computer) can be set.

If “MASS METER” was selected, no volume engineering units can be displayed and vice versa.



Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

If the meter mode is changed, the display shows:

WARNING: CHANGING THE
METER MODE WILL CAUSE
ALL COUNTERS TO RESET
PROCEED EXIT

Confirm with “PROCEED” or skip with “EXIT”.

If “PROCEED” is pressed, the display shows:

OPERATION MODE HAS
BEEN CHANGED TO
VOLUME METER
OK

If “EXIT” is pressed, the display shows:

THE OPERATION MODE
SETTINGS
WERE NOT CHANGED
OK

After “OK” the display returns to the “SETUP - PARAMETER” menu.

4.5.6.2. Gas measuring mode (optional)



After confirming with “P”, you will be asked to make the settings required for the gas measuring mode.

Firstly, you have to enter the reference density to be used in determining the standard volume of gases ($V_n = m / \rho_{ref}$). Entries are made in the current density unit.



The standardized volume flow and the total volume are displayed in standardized volume units. Chapter 4.5.4.5 explains the selection of the unit.

The TRICOR CLASSIC NetOil-Manual (www.tricorflow.com/manuals/), page 14 ff., shows additional settings for the gas measuring mode.

4.5.6.3. CUT OFF Menu

In the submenu “CUT OFF” the “CUT OFF” values can be set.

There are 2 different “CUT OFF” values:

FLOW:

If the absolute value of the measured and filtered flow is below the “CUT OFF” value, the calculated flow is set to zero and consequently all outputs show zero flow and the “TOTAL” and batch value remain unchanged.

DENSITY:

If the current density is below the “CUT OFF” value, the calculated flow is set to zero and consequently all outputs show zero flow and the total and batch value remain unchanged.

The density “CUT OFF” does not influence the density display. Also density below the cut off will be measured and displayed.



Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.



Manual Operation

FLOW

Typical values for the flow “CUT OFF” are in the range 0.3 ...1 %. With “CUT OFF” values set too low, noise or any external interference might be misinterpreted as real flow. Using too high “CUT OFF” values, low flows might not be correctly registered anymore.

The preset “CUT OFF” should always be significantly smaller than the lowest flow to be measured.

NOTE:

Flow “CUT OFF” is defined as mass flow. In volume meter mode recalculate the percentage to mass flow and/or use the density “CUT OFF”.



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “CUT OFF” menu.

DENSITY Liquid



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “CUT OFF” menu.

DENSITY Gas



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “CUT OFF” menu.

4.5.6.4. STEP RESPONSE Menu

In the submenu “RESP STEP” the reaction to fast changing flows can be optimized.

NOTE:

This submenu is disabled, if the option “FAST RESPONSE” is not implemented.

If the difference between the measured flow and the filtered flow is higher than “STEP RESPONSE”, the filter is cleared and filled with the new value. If it is smaller than the “STEP RESPONSE” value, the flow filter remains active.

The optimum value depends on the individual situation. For ON/OFF operation a value of half the ON flow is recommended.

For deactivating "STEP RESPONSE" set the value to 99 %.

NOTE:

A too low value leads to unstable readings for flow whereas too high values will disable the function.



Use the keys "RIGHT" and "UP" to select the desired value and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - PARAMETER" menu

4.5.6.5. RESET KEY Menu

In the submenu "RESET KEY" the pushbutton "Reset" can be enabled or disabled.

If the pushbutton "Reset" is active, it can be used to reset the batch counter.



Use the keys "UP" and "DOWN" to enable or disable the key and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - PARAMETER" menu.

4.5.6.6. FLOW DIRECTION Menu

In the submenu "FLOW-DIREC" the positive direction of the flow can be set.

If the flow direction is set to "FORWARD" (default setting), a flow through the meter in direction of the arrow, indicated on the type label of the meter, will be displayed positive and the opposite flow negative.

If for technical reasons the meter must be mounted in that way, that the normal flow is against the direction of the arrow, the sign of the flow can be inverted by setting flow direction to "REVERSE".



Use the keys "UP" and "DOWN" to select the positive flow direction and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - PARAMETER" menu.



4.5.6.7. K-FACTOR Menu

In the submenu “K-FACTOR” the K-factor for the fine tuning of the flow calculation can be set.

Ex works the TRICOR CLASSIC Mass Flow Meter is calibrated with a K-factor $k = 1.0000$. If for any reasons the flow measured by the Mass Flow Meter differs slightly from a flow measured with other means, the value calculated by the TCM can be adjusted by changing the K-factor without the need to perform a new flow calibration.



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu.

4.5.6.8. FAULT TIME Menu

In the submenu “FAULT TIME” the reaction time of the TCE 8000 in case of an error can be defined.

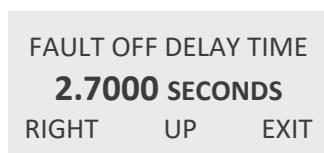
The “FAULT ON DELAY TIME” is the time an error must be present, before the red LED lights up and the error output signal is activated.

The “FAULT OFF DELAY TIME” is the time an error signal persists on the red LED and on the control output, after the error disappeared.



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display shows



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - PARAMETER” menu.

4.5.6.9. PRESSURE COMPENSATION Menu

In the submenu “PRESS. COMP” the operational mode of the “PRESSURE COMPENSATION” (option) can be set.

NOTE:

This menu is only visible with the option “PRESSURE COMPENSATION”.

The following modes are possible:

OFF:

No pressure compensation.

mA-IN I1:

The pressure measured via the analog 4 ... 20 mA input is used for the compensation.

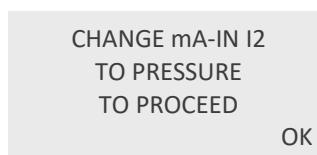
MANUAL:

The pressure set manually or via the interface is used for the compensation.



Use the keys "UP" and "DOWN" to select the desired mode and confirm with "P" or skip with "EXIT".

Is "mA-IN I1" selected but the status of the analog input is "OFF", the display shows



Confirm with "OK". Configure the analog input correspondingly (see chapter 4.5.8.5) and repeat the setting.

If "MANUAL" is selected, the display shows



Use the keys "RIGHT" and "UP" to select the desired value and confirm with "P" or skip with "EXIT".

The display returns to the "PRESS. COMP.". menu.

4.5.6.10. TOTAL COUNT Menu

In the submenu "TOTAL COUNT" the "TOTAL" counter can be configured.

The following operating modes are available:

DEFAULT:

The "TOTAL" count includes flow in positive as well as in negative direction. With positive flow the TOTAL value increases, with negative flow it decreases.

FORWARD:

The "TOTAL" count includes only flow in positive direction. With negative flow the TOTAL value does not change.

BACKWARD:

The "TOTAL" count includes only flow in negative direction. With positive flow the TOTAL value does not change.



Use the keys "UP" and "DOWN" to select the mode and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - PARAMETER" menu.

4.5.6.11. LANGUAGE Menu

In the submenu "LANGUAGE" the language used in the display can be selected.

For the time being, English and Russian can be selected.



Use the keys "UP" and "DOWN" to select the language and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - PARAMETER" menu.

4.5.7. SETUP - FILTER Menu

In the submenu "SETUP - FILTER" the filters of TCE can be configured.



Use the keys "UP" and "DOWN" to select the desired submenu and confirm with "P" or skip with "EXIT".

4.5.7.1. FLOW FILTER Menu

In the submenu "FLOW" the time constant for the flow filter can be set.

The time constant t is the time the output needs after a jump from x to 0 to go to $x/e = x/2.72$.

A rough relation between the time and the filtered flow value after a jump is

| Elapsed time | Remaining error (% of the step) |
|--------------|------------------------------------|
| 1 * t | 30 |
| 2 * t | 10 |
| 3 * t | 3 |
| 4 * t | 1 |



Use the keys "RIGHT" and "UP" to select the desired value and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - FILTER" menu.

4.5.7.2. DENSITY FILTER Menu

In the submenu "DENS" the time constant for the density filter can be set.

The time constant t is the time the output needs after a jump from x to 0 to go to $x/e = x/2.72$.

A rough relation between the time and the filtered flow value after a jump is

| Elapsed time | Remaining error (% of the step) |
|--------------|------------------------------------|
| 1 * t | 30 |
| 2 * t | 10 |
| 3 * t | 3 |
| 4 * t | 1 |



Use the keys "RIGHT" and "UP" to select the desired value and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - FILTER" menu.

4.5.8. SETUP - IN/OUTPUTS Menu

In the submenu "SETUP - IN/OUTPUTS" the input and output ports can be configured.



Use the keys "UP" and "DOWN" to select the desired submenu and confirm with "P" or skip with "EXIT".

4.5.8.1. FREQUENCY OUT Menu

In the submenu "FREQ OUT" the frequency output can be configured.

The frequency output has two operating modes:



FREQUENCY:

A frequency proportional to the actual flow is generated. If a negative flow must be given out as well, the control output can be used as sign. Frequencies between 0.5 Hz and 10 kHz can be generated in this mode.

TOTAL COUNT:

Each time the “TOTAL” increments by the selected “TOTAL” increment step, the output produces a pulse. For having a 50 % duty cycle, the output changes its state each time after half the increment step. If the flow is negative in between, no pulses are generated until the following positive flow compensates for the negative flow in between. Thus the medium will not be counted twice, if in between a flow backwards occurs. The maximum output frequency which can be generated in this mode is about 100 Hz.



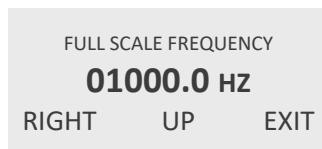
Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

FREQUENCY



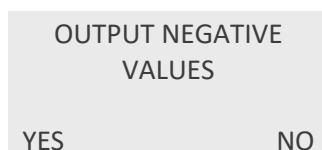
Use the keys “RIGHT” and “UP” to select the desired full scale value and confirm with “P” or skip with “EXIT”.

The display shows

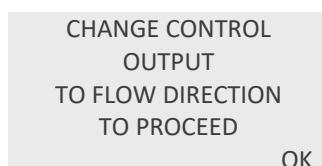


Use the keys “RIGHT” and “UP” to select the desired frequency and confirm with “P” or skip with “EXIT”.

The display shows



If “YES” is selected and the control output is not configured as “FLOW DIREC”, the display shows



Confirm with “OK”, configure the control output correspondingly, (see chapter 4.5.8.2) and repeat the setting.

TOTAL COUNT

Use the keys "RIGHT" and "UP" to select the desired step value and confirm with "P" or skip with "EXIT".

4.5.8.2. CONTROL OUT Menu

In the submenu "CTRL OUT" the control output can be configured.

The control output has four operating modes:

FAULT:

In case of an error the control output goes to the active state.

"ACTIVE HIGH" means the output is low in normal operation, high in case of a fault.

For setting the on and off delay time, please refer to chapter 4.5.6.8.

FLOW DIR:

The flow direction is indicated. "ACTIVE HIGH" means the output is high if a positive flow is measured.

BATCH:

In the batch mode the TCE 8000 operates as a batch counter. If the preset batch value is reached, the control output goes to the active state. With an active signal at the control input the batch counter can be reset to zero. For this mode the control input must be configured as "RESET BATCH". "ACTIVE HIGH" means the output goes to "HIGH" when the preset batch value is reached.

FLOW LIMIT:

If the actual flow becomes more positive than the "FLOW LIMIT" plus hysteresis, the output goes to the active state. If the actual flow becomes more negative than the "FLOW LIMIT" minus hysteresis, the output goes to the inactive state. Between flow limit minus hysteresis and flow limit plus hysteresis, the output state does not change.

NOTE:

For negative flow limits the relation is: -99 is greater than -100.

"ACTIVE HIGH" means the output goes to "HIGH" when the preset limit value is reached.

OFF:

The output is deactivated. "ACTIVE HIGH" means the output is permanently at high.

FREQUENCY:

A frequency proportional to the current flow rate is generated. Frequencies between 0.5 Hz and 10 kHz can be generated in this mode.

DENS. LIMIT:

When the measured density exceeds the value for DENS. LIMIT plus the hysteresis, the output enters the active state. When the density becomes less than DENS. LIMIT minus the hysteresis, the output enters the inactive state. The output does not change in between the two thresholds.

PHASE SHIFT:

Prerequisite: the FREQ-OUT has been programmed for TOTAL COUNT. As soon as "TOTAL" has increased by the chosen amount, another pulse is generated on FREQ OUT. To have a frequency ratio of 50 % on the output, the state of the output changes respectively after half the amount. A pulse offset by 90° is also generated on CTRL OUT after each pulse on FREQ-OUT.

The maximum output frequency in this operating mode is about 50 Hz.



Manual Operation

FAULT



Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

FLOW DIR



Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

BATCH



Use the keys “RIGHT” and “UP” to select the desired step value and confirm with “P” or skip with “EXIT”.

The display shows



Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

FLOW LIMIT



Use the keys “RIGHT” and “UP” to select the desired step value and confirm with “P” or skip with “EXIT”.

The display shows



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

The display shows

SELECT ACTIVE STATE
ACTIVE HIGH
 UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

OFF

CTRL OUT MENU
OFF
 UP DOWN EXIT

P →

SELECT ACTIVE STATE
ACTIVE HIGH
 UP DOWN EXIT

Confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

FREQUENCY

FREQ OUT MENU
FREQUENCY
 UP DOWN EXIT

P →

FULL SCALE FLOW
8000.0 G/s
 RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired full scale value and confirm with “P” or skip with “EXIT”.

The display shows

FULL SCALE FREQUENCY
01000.0 Hz
 RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired frequency and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

4.5.8.3. ANALOG OUT Menu

In the submenu “mA-OUT” the 4 ... 20 mA outputs can be configured.

Each analog output can show one of the following parameters:

FLOW:

The output current is proportional to the flow.

DENSITY:

The output current is proportional to the density.

TEMP:

The output current is proportional to the temperature.

BATCH COUNT:

The output current is proportional to the current batch value.

This mode is only possible, if the control input is configured as “RESET BATCH”



Manual Operation

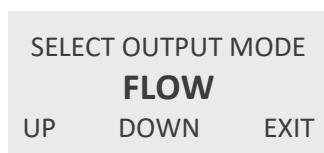
The value for 4 mA as well as the value for 20 mA can be freely selected. Thus it is possible to zoom in (e.g. temperatures from 20 °C to 30 °C [68 °F up to 86 °F]) or to show negative values as well (e.g. flow from -10 kg/min to +20 kg/min).



Use the keys "UP" and "DOWN" to select the desired output channel and confirm with "P" or skip with "EXIT".

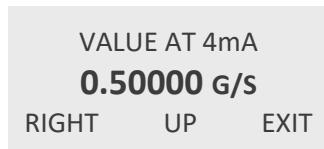
The standard TCE electronics provides two analog 4 ... 20 mA outputs, I1 and I2. If the option "PRESSURE COMPENSATION" is installed, only the output I2 is available.

The display shows



Use the keys "UP" and "DOWN" to select the desired output value and confirm with "P" or skip with "EXIT".

The display shows



The indicated engineering unit depends on the selected output value and the display setup.

To input a negative sign (e.g. for -20 °C), move the cursor to the first digit. When the figures are incremented by pushing "UP", the "9" is followed by the minus sign "-", before the "0" appears.

Use the keys "RIGHT" and "UP" to select the desired value for 4 mA and confirm with "P" or skip with "EXIT".

The display shows



Use the keys "RIGHT" and "UP" to select the desired value for 20 mA and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - IN/OUTPUTS" menu.

4.5.8.4. CONTROL IN Menu

In the submenu "CTRL IN" the control input can be configured.

The control input has three operating modes:

EXT. ZERO:

If an "ACTIVE" level is applied to the input, the TCE 8000 starts the zero offset adjustment procedure.

RESET BATCH:

If an "ACTIVE" level is applied to the input, the batch counter is reset to 0.

This mode must be selected, if the control output is to be used as a "BATCH-LIMIT" and/or if one of the analog outputs is to be used as batch output.

OFF:

The input is deactivated. Changes of the level applied to the input have no effect. This is the default. The “ACTIVE” level is freely selectable. Since the standard version of TCE has an internal pull-down resistor built in, the default is “ACTIVE HIGH”.

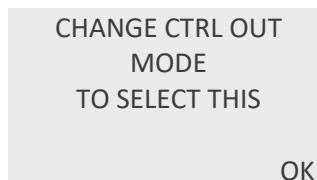
HOLD:

If an “ACTIVE” level is applied to the input, the batch and grand totals stop counting.



Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

If “EXT. ZERO” or OFF is selected and one of the outputs is set to batch output, the display shows



Confirm with “OK” and configure the output correspondingly if required.

The display shows



Use the keys “UP” and “DOWN” to select the desired value and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

4.5.8.5. ANALOG IN Menu

In the submenu “mA-IN I1” the 4 ... 20 mA input can be configured. This menu is only visible with the option “PRESSURE COMPENSATION”.

The value for 4 mA as well as the value for 20 mA can be freely selected to adapt the input to any passive 4 ... 20 mA pressure sensor.



Use the keys “UP” and “DOWN” to select “OFF” or “PRESSURE” and confirm with “P” or skip with “EXIT”.

If “OFF” is selected, neither a pressure value is shown nor a pressure compensation using a measured pressure value is possible.



Manual Operation

If “PRESSURE” was selected the display shows

VALUE AT 4mA
0.00 MPA
RIGHT UP EXIT

The indicated engineering unit depends on the selected output value and the display setup.

Use the keys “RIGHT” and “UP” to select the desired value for 4 mA and confirm with “P” or skip with “EXIT”.

The display shows

VALUE AT 20mA
10.00 MPA
RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to select the desired value for 20 mA and confirm with “P” or skip with “EXIT”.

The display returns to the “SETUP - IN/OUTPUTS” menu.

4.5.8.6. INTERFACE Menu

In the submenu “INTERFACE” the interface can be configured.

Depending on the configuration one or more of the following interfaces can be selected:

RS485

HART®

Foundation Fieldbus®

IN/OUTPUTS MENU
INTERFACE
UP DOWN EXIT →
SET INTERFACE MODE
RS485
UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the desired mode and confirm with “P” or skip with “EXIT”.

RS485

Data transmission is carried out via RS485 interface with the „Modbus RTU“ protocol.

SET INTERFACE MODUS
RS485
UP DOWN EXIT →
SELECT BAUD RATE
57600
MODBUS
UP DOWN EXIT

Use the keys “UP” and “DOWN” to select the baud rate and confirm with “P” or skip with “EXIT”.

The display shows

SELECT BYTE ORDER
3-2-1-0
RIGHT UP EXIT

Use the keys "UP" and "DOWN" to select the byte order for floating point numbers as it is valid with your system and confirm with "P" or skip with "EXIT".

The display shows

ADDITIONAL TIME DELAY
00800. μ s
RIGHT UP EXIT

If the device is installed within bigger bus and controlling systems, it might be helpful to slow down additionally the response of the TCE 8000 in order to avoid any communication errors.

Use the keys "RIGHT" and "UP" to select the additional time delay and confirm with "P" or skip with "EXIT".

The display shows

SET UNIT ADDRESS
001
RIGHT UP EXIT

The following addresses cannot be set:

| Address | Function |
|---------|--|
| 0 | reserved for broadband communication (messages to all connected units) |
| 248-255 | reserved for special Modbus purpose |

Use the keys "RIGHT" and "UP" to select the desired unit address and confirm with "P" or skip with "EXIT".

The display returns to the "SETUP - IN/OUTPUTS" menu.

HART®

For the HART® interface special local settings are not available. All configurations are done directly via the interface.

The HART® interface is just activated and the display returns to the SETUP IN/OUTPUTS menu.

Foundation Fieldbus®

For the Foundation Fieldbus® interface special local settings are not available. All configurations are done directly via the interface.

The Foundation Fieldbus® interface is just activated and the display returns to the "SETUP - IN/OUTPUTS" menu.



4.5.9. SETUP - DATA CONFIGURATION Menu

In the submenu “SETUP - DATA CONFIG” the current settings can be stored to the backup memory and the stored settings can be recalled



Use the keys “UP” and “DOWN” to select the desired submenu and confirm with “P” or skip with “EXIT”.

4.5.9.1. SAVE DATA Menu

In the submenu “SAVE DATA” the current settings can be stored in the backup memory.

At each power on the TCE 8000 compares the content of the setup memory and the backup memory. If the data in those two memories are different, the TCE 8000 gives out a warning. To avoid this warning, it is recommended to make a backup as soon as the new settings are proven to be okay.



Start the backup process with “START” or skip with “EXIT”.

If “START” is pressed, the display shows for some seconds

MEMORY
ACCESS

After that for about two seconds

READY

The display returns to the “SETUP - DATA CONFIG” menu.

4.5.9.2. RECALL DATA Menu

In the submenu “RECALL DATA” the old settings are reloaded from the backup memory.

Reloading the old settings is recommended, if after bigger changes in the setup the TCM does not work properly any more.

NOTE:

Backup data overwritten with “SAVE DATA” cannot be restored!



Start the recall process with “START” or skip with “EXIT”.

If “START” is pressed, the display shows for some seconds

MEMORY
ACCESS

After that for about two seconds

READY

The display returns to the “SETUP - DATA CONFIG” menu.

4.5.10. SETUP - RESET TOTAL Menu

In the submenu “SETUP - RESET TOTAL” the “TOTAL” counters can be reset to zero



Reset the “TOTAL” with “START” or skip with “EXIT”.

NOTE:

All TOTAL values (“GRAND TOTAL”, “BATCH TOTAL” and “FAIL. TOTAL”) are reset!

The display returns to the “SETUP - RESET TOTAL” menu.

4.5.11. SETUP - CLEAR LOGS Menu

In the submenu SETUP - CLEAR LOGS all logged events can be acknowledged (deleted).



Acknowledge all logged events with „START” or skip with „EXIT” ab.

NOTE:

Acknowledged Log entries cannot be recovered.

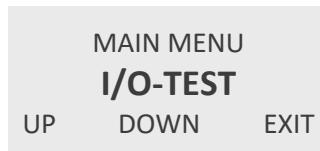
Das Display kehrt zum Menü CLEAR LOGS zurück.



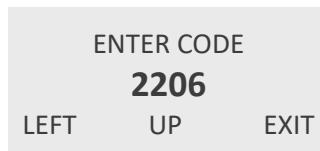
4.5.12. I/O-TEST Menu

In the “I/O-TEST” menu all inputs and outputs can be tested.

Select in the main menu



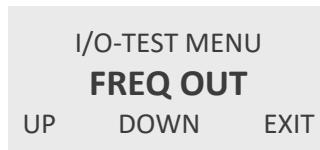
Press “P”. The display shows



Change the indicated number with “LEFT” and “UP” to “2207” and confirm with “P”.

If a wrong code is entered, the display shows “ERROR” for about two seconds and then asks for a new input.

When the correct code is entered the display shows



The following submenus are available:

| | |
|----------|--|
| FREQ OUT | A freely settable frequency can be applied to the output |
| CTRL OUT | The output level can be set |
| mA-OUT | A freely settable current can be applied to the output |
| CTRL IN | The level currently applied to the input is indicated |
| mA-IN | The current input current is indicated (Only with option “PRESSURE COMPENSATION”) |

When the “I/O-TEST” menu is left, all outputs return to normal operation.

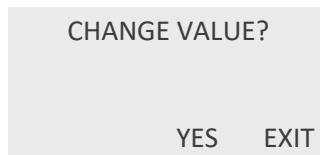
4.5.12.1. I/O-TEST - FREQUENCY OUT Menu

In the submenu “FREQ OUT” a freely settable frequency, between 1 Hz and 9,999 Hz, can be applied to the output.



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

If “P” was pressed the frequency is applied to the output and the display shows



Press “YES” to enter a new value or “EXIT” to leave the menu.

If “EXIT” is pressed, the display returns to the “SETUP - I/O-TEST” menu.

4.5.12.2. I/O-TEST - CONTROL OUT Menu

In the submenu “CTRL OUT” a low or high level can be applied to the output.



Use the keys “HIGH” and “LOW” to set the output value or leave the menu with “EXIT”.

If “EXIT” is pressed, the display returns to the “SETUP - I/O-TEST” menu.

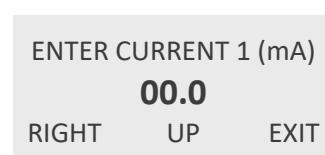
4.5.12.3. I/O-TEST - ANALOG OUT Menu

In the submenu “mA-OUT” a freely settable current, between 2 mA and 22 mA, can be applied to the output.



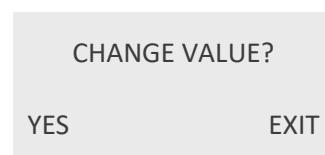
Use the keys “UP” and “DOWN” to select the desired output and confirm with “P” or skip with “EXIT”.

The display shows



Use the keys “RIGHT” and “UP” to select the desired value and confirm with “P” or skip with “EXIT”.

If “P” was pressed the current is applied to the output and the display shows



Press “YES” to enter a new value or “EXIT” to leave the menu.

If “EXIT” is pressed, the display returns to the “SETUP - I/O-TEST” menu.



4.5.12.4. I/O-TEST - CONTROL IN Menu

In the submenu “CTRL IN” the display shows the level currently applied to the control input.



The display shows the actual level at the input. It is automatically updated when the level at the input has changed.

After evaluating the input, press “EXIT” to return to the “SETUP - I/O-TEST” menu.

4.5.12.5. I/O-TEST - ANALOG IN Menu (optional)

The submenu “mA-IN” is only selectable with the option “PRESSURE COMPENSATION”.

In the submenu “mA-IN” the display shows the current applied to the control input.



After evaluating the input, press “EXIT” to return to the “SETUP - I/O-TEST” menu.

4.5.13. SERVICE Menu

The “SERVICE” menu is used to calibrate the meter, to set a user password and to recall the original factory settings.

For a description of the menu, please refer to chapter 6.

5. Remote Operation

As a standard, the TCE 8000 is equipped with RS485 and HART® interfaces. Foundation Fieldbus® is also available as an option.

Please read chapter 4 before installing a remote control, for getting a description of the functionality.

5.1. Serial RS485 Interface

5.1.1. Electrical Connection of RS485 Interface

Prepare the TCE 8000 and the cable as described in chapter 3.3.

Connect the signal RS485A or RS485+ (both names are used in the literature) to terminal 22 and RS485- or RS485B to terminal 21.

Terminal 20 is the ground reference pin for the interface and is connected to GND (terminal 8) with the non-Ex versions and connected to PE (terminal 52) with the Ex versions.

NOTE:

The operating range of the data terminals (21 and 22) is -7 V to +12 V referred to the reference pin (20). Voltages outside that range could damage the TCE 8000.

5.1.2. Usage of the TRICOR Configurator

The control software TRICOR Configurator as well as the corresponding manual is provided for download at the “Download” area of the TRICOR webpage (www.tricorflow.com/manuals/).

Using the TRICOR Configurator a remote operation with TRICOR CLASSIC meters is possible, without the need of knowledge about the Modbus protocol.

The usage of the converter CON.USB.RS-ISO is recommended for the connection between the TCE electronics and a personal computer (via USB interface).

5.1.3. RS485-Interface-Protocol

For communication via RS485 the Modbus RTU protocol is used.

A detailed description of the Modbus frame structure and the implemented registers and addresses can be found at the “Download” area of the TRICOR webpage (www.tricorflow.com/manuals/).



5.2. HART®

5.2.1. Electrical Connection for HART®

For the HART® communication the current output CURRENT 2 (I2) is used.

Connect the analog output CURRENT 2 as described in chapter 3.3.8 and connect a HART® communicator or a HART® Handheld Terminal in series to the analog output of the TCE.

Refer to the manual of your HART® communicator, respectively of the HART® Handheld Terminal, for the proper connection.

5.2.2. Device Description File for HART® Interface Protocol

For getting the newest DD file for the HART® Interface, please contact your TRICOR representative.

5.3. Foundation Fieldbus®

5.3.1. Electrical Connection for Foundation Fieldbus®

Prepare the TCE 8000 and the cable as described in chapter 3.3.4 or 3.3.5.

Connect the signal FF+ (positive rail of the bus) to terminal 32 and FF- (negative rail of the bus) to terminal 31.

5.3.2. Device Description File for Foundation Fieldbus® Interface Protocol

For getting the newest DD file for the Foundation Fieldbus® Interface, please contact TRICOR representative.

6. Service and Maintenance

6.1. Maintenance

The TRICOR CLASSIC Mass Flow Meters do not require regular maintenance.

In case of abrasive or sedimenting media however, it is recommended to return the measuring system to the manufacturer after 8,000 hours of operation for re-calibration and pressure test. This interval may be shorter when the medium is extremely abrasive or sedimenting. For best performance we recommend checking the calibration every 5 years, in harsh environments even more frequently.

If for the specific application an obligatory calibration is required, refer to the corresponding national regulations for the necessary calibration intervals.

6.2. Trouble Shooting

In case the TRICOR Mass Flow Meter does not work properly, first check the following items:

No display, no LED lighting

All cables properly connected?

→ Connect the missing cables

Power supply switched on?

→ Switch on the power supply

Display positioned properly (compact and wall mount only)?

→ Remove the display and reset it properly

Internal fuse of the TCE blown?

→ For checking and changing the fuses refer to chapter 6.3.

Output frequency too high or unstable

Most probably EMC problems

Shield and ground properly connected?

→ Connect shield properly. If necessary, try additional means of grounding and shielding

Unstable flow reading with (theoretically) stable flow

Gas bubbles or solid particles in the medium?

→ Mount the meter with the correct orientation

Strong external vibrations?

→ Decouple the meter from the vibration source

Flow or pressure slugs in the medium?

→ Decouple the meter hydraulically

No frequency or current output with operating display

Output correctly wired?

→ Correct the wiring (see chapter 2.3)

Output correctly configured?

→ Correct the configuration (see chapter 4.5.8)

Wrong flow direction (flow in the display is negative)?

→ Change flow direction (see chapter 4.5.6.6)

Pressure display shows "PRESS ERROR"

Input correctly wired?

→ Correct the wiring (see chapter 2.3)

Sensor working normally?

→ Check with external digital Ampere meter. If required, replace the sensor

No pressure compensation

Compensation enabled?

→ Enable compensation (see chapter 4.5.6.9)

Sensor working normally?

→ Check with external digital Ampere meter. If required, replace the sensor



6.3. Maintenance and Repair Work

WARNING!

Impermissible repair of explosion protected devices

Risk of explosion in hazardous areas

Repair must be carried out by persons authorised by the manufacturer..

WARNING!

Maintenance during continued operation in a hazardous area

There is a risk of explosion when carrying out repairs and maintenance on the device in a hazardous area.

Isolate the device from power. - or -

Ensure that the atmosphere is explosion-free (hot work permit).

WARNING!

Impermissible accessories and spare parts

Risk of explosion in areas subject to explosion hazard.

Only use original accessories or original spare parts.

Observe all relevant installation and safety instructions described in the instructions for the device or enclosed with the accessory or spare part.

WARNING!

Humid environment

Risk of electric shock.

Avoid working on the device when it is energized.

If working on an energized device is necessary, ensure that the environment is dry.

Make sure when carrying out cleaning and maintenance work that no moisture penetrates the inside of the device.

CAUTION!

Hot parts in the device

Temperatures that can burn unprotected skin may be present for some time after the device has been switched off.

Observe the waiting time specified in "Technical Data" (see chapter 7.3) before starting with maintenance work.

WARNING!

Enclosure open

Risk of explosion in hazardous areas as a result of hot components and/or charged capacitors inside the device.

To open the device in a hazardous area:

1. Isolate the device from power.
2. Observe the wait time specified in "Technical Data" (see chapter 7.3) before opening the device.
3. Visually inspect sensor inlet and outlet.

Exception: Devices exclusively having the type of protection "Intrinsic safety Ex i" may be opened in an energized state in hazardous areas.

CAUTION!**Hazardous voltage at open device**

Risk of electric shock when the enclosure is opened or enclosure parts are removed.

Before you open the enclosure or remove enclosure parts, de-energize the device.

If maintenance measures in an energized state are necessary, observe the particular precautionary measures.

Have maintenance work carried out by qualified personnel.

WARNING!**Hot, toxic or corrosive process media**

Risk of injury during maintenance work.

When working on the process connection, hot, toxic or corrosive process media could be released.

As long as the device is under pressure, do not loosen process connections and do not remove any parts that are pressurized.

Before opening or removing the device ensure that process media cannot be released.

WARNING!**Improper connection after maintenance**

Risk of explosion in areas subject to explosion hazard.

Connect the device correctly after maintenance.

Close the device after maintenance work.

The device is maintenance-free. However, a periodic inspection according to pertinent directives and regulations must be carried out.

An inspection can include check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover screws
- Reliability of power supply, lightning protection, and grounds

NOTE:

Repairs and service may only be carried out by persons authorised by the manufacturer.

NOTE:

The manufacturer defines flow sensors as non-repairable products.

Maintenance information parameters

The basic maintenance information parameters are:

- Current Date and Time
- Operating Time Total
- Operating Time
- Configuration Counter
- Transmitter Hardware Revision
- HMI Hardware Revision
- Sensor Hardware Revision



6.3.1. Changing the fuse with the TCE 8***-wall mounted-*** and compact version

The power supply inputs of the TCE 8000 contain fuses. With the non-Ex versions the fuses can easily be replaced by qualified personnel.

Switch off the power supply.

Open the safety screw at the display cover of the unit with the provided Allen key.

Remove the display cover of the TCE by turning it counter clockwise.

Pull out the display

Remove the 3 screws in the PCB and pull it out carefully.

Below the ribbon cable connector you find the following fuse in the fuse holder:

Littelfuse NANO 2 375mA slow blow, ordering code 0452.375

NOTE:

For your own safety replace the fuse only by the same type and rating.

Replace the fuse and reclose the unit.

6.3.2. Changing the fuse with the TCE 8***-S-***

Switch off the power supply.

Remove the 4 screws in the back panel and pull out the back panel carefully.

Below the ribbon cable connector you find the following fuse in the fuse holder:

Littelfuse NANO 2 375mA slow blow, ordering code 0452.375

NOTE:

For your own safety replace the fuse only by the same type and rating.

Replace the fuse and reclose the unit.

6.3.3. Changing the fuses with the Ex versions

With the Ex versions the fuses are part of the safety barriers and must only be exchanged by KEM/AWL or by personnel authorized by KEM/AWL.

In case one of the fuses has blown, contact KEM/AWL or your nearest dealer.

WARNING!

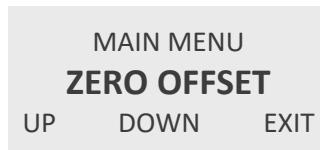
The Ex versions of the TCE 8000 series contain several internal fuses for protecting the intrinsically safe TCM against too high voltage and power. Those fuses are critical parts and must not be exchanged except by KEM/AWL or by service personnel authorized by KEM/AWL. If the fuses are replaced by third persons, the Ex certification for the TCM will be void!

6.4. Calibration

In the "SERVICE" menu all measurements of the TCE 8000 can be calibrated.

Press "P" for about three seconds

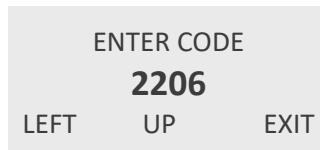
The display shows



Use the key "UP" or "DOWN" to select



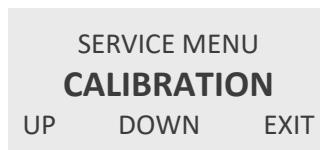
Press "P". The display shows



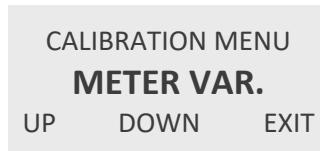
Change the indicated number with "LEFT" and "UP" to "2208" and confirm with "P".

If a wrong code is entered, the display shows "ERROR" for about two seconds and then asks for a new input.

When the correct code is entered the display shows



Press "P". The display shows



The following submenus are available:

| | |
|--------------|---|
| TEMP CALIB. | Calibrating the temperature measurement |
| AIR CALIB. | Calibrating the density measurement at low density (air) |
| WATER CALIB. | Calibrating the density measurement at high density (water) |
| METER VAR. | Calibrating the flow measurement |



6.4.1. Temperature Calibration

For calibrating the temperature reading of the TCE 8000, the medium temperature must be well known.

Before starting the calibration, make sure that the temperature reading has been stable for several minutes, to make sure that the medium temperature and the temperature of the temperature sensor are the same.



Use the keys "RIGHT" and "UP" to set the actual medium temperature and confirm with "P" or skip with "EXIT".

The display returns to the "SERVICE - CALIBRATION" menu.

6.4.2. Air Density Calibration

The low end calibration of the density measurement is normally done with empty tubes (filled with air).

In the automatic mode the unit performs an automatic calibration, assuming that the tubes are filled with normal air.

In the manual mode the three parameters temperature, tube frequency and reference density can be altered individually. This is necessary if the air calibration is performed with a gas with a density different than air. In that case make first the automatic calibration and then override in the manual calibration the density value by the density of the medium used for calibration.

Before starting an automatic calibration, make sure that the TCM is completely empty as any drop of a liquid inside will spoil the calibration result.

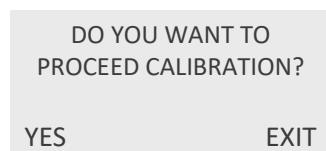


Use the keys "UP" and "DOWN" to select the desired mode and confirm with "P" or skip with "EXIT".

AUTOMATIC mode:



Confirm with "OK". The display shows:



Start the calibration with "YES" or skip with "EXIT".

If "YES" was pressed, the display shows:

| | |
|------------|----------|
| AIR TEMP: | 23.0°C |
| FREQUENCY: | 141.4 Hz |
| DENSITY: | 1.4 G/L |
| OK | |

Confirm with "OK". The display returns to the "AIR CALIBRATION" menu.

MANUAL mode:



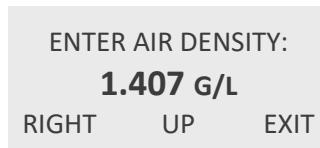
The image shows two display screens. The left screen displays the "AIR CALIBRATION MENU" with "MANUAL" selected. Below the menu are three buttons: "UP", "DOWN", and "EXIT". An arrow points from this screen to the right screen, which displays "ENTER AIR TEMP:" with "23.0 °C" entered. Below the entry are three buttons: "RIGHT", "UP", and "EXIT".

Use the keys "RIGHT" and "UP" to set the reference temperature and confirm with "P" or skip with "EXIT". The display shows:



The image shows a display screen with "ENTER AIR FREQ:" at the top, followed by "141.52 Hz" in a larger font. Below the entry are three buttons: "RIGHT", "UP", and "EXIT".

This value must only be entered, if you have the data from a calibration sheet of the TCM. Skip with "EXIT". The display shows



The image shows a display screen with "ENTER AIR DENSITY:" at the top, followed by "1.407 G/L" in a larger font. Below the entry are three buttons: "RIGHT", "UP", and "EXIT".

Use the keys "RIGHT" and "UP" to set the reference density and confirm with "P" or skip with "EXIT".

The display returns to the "AIR CALIBRATION" menu.

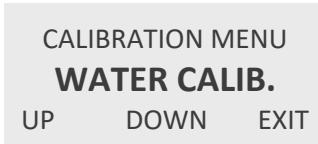
6.4.3. Water Density Calibration

The high end calibration of the density measurement is normally done tubes filled with water. Butanol or other liquids with well-known density can be used as well.

In the automatic mode the unit performs an automatic calibration, assuming that the tubes are filled with water.

In the manual mode the three parameters temperature, tube frequency and reference density can be altered individually. This is necessary if the water calibration is performed with a liquid with a density different than water. In that case make first the automatic calibration and then override in the manual calibration the density value by the density of the medium used for calibration.

Before starting an automatic calibration, make sure that the TCM is completely filled with the reference medium. Any pollution (air bubbles, solid particles or rests of other liquids) will spoil the calibration result.



P →

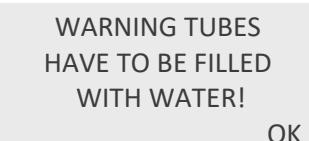


Use the keys "UP" and "DOWN" to select the desired mode and confirm with "P" or skip with "EXIT".

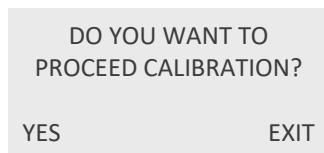
AUTOMATIC mode:



P →

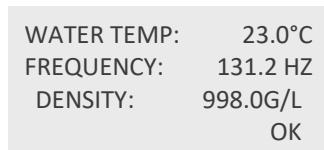


Confirm with "OK". The display shows:



Start the calibration with "YES" or skip with "EXIT"

If "YES" was pressed, the display shows:



Confirm with "OK". The display returns to the "WATER CALIBRATION" menu.

MANUAL mode:



P →



Use the keys "RIGHT" and "UP" to set the reference temperature and confirm with "P" or skip with "EXIT".

The display shows:



This value must only be entered, if you have the data from a calibration sheet of the TCM. Skip with “EXIT”.

The display shows

ENTER WATER DENSITY:
998.03 G/L
RIGHT UP EXIT

Use the keys “RIGHT” and “UP” to set the reference density and confirm with “P” or skip with “EXIT”.

The display returns to the “WATER CALIBRATION” menu.

6.4.4. Flow Calibration

Mount the TCM in the test stand or mount a reference meter in series to the TCM to be calibrated. The accuracy of the test stand or reference meter must be better than 0.1 % of reading over the calibration range.

For best results with the zero offset calibration, a valve each in front and behind the TCM is recommended.

NOTE:

All mounting guidelines (see chapter 3) must be observed!

Any erroneous reading due to bad mounting will lead to a wrong calibration!

Operate the meter for at least 15 minutes for making sure that it has reached the final operating temperature. If the medium temperature differs much from the initial meter or ambient temperature, a longer warm up period might be recommended.

Close the valves and make the zero offset adjustment (see chapter 4.3.5 and 4.5.3).

If the calibration of the TCM shall be checked without adjusting the reading, just compare the TCM reading with the reading of the reference meter at the desired flow rates.

If the TCM shall be adjusted according to the test results, make a test run (or better several tests runs) at about 50 % of the TCM full scale flow.

Read the current TCM meter variable:

| | | |
|------------------|------|---------------|
| CALIBRATION MENU | P → | SET METER VAR |
| METER VAR. | | 196.0 |
| UP | DOWN | EXIT |
| RIGHT | UP | EXIT |

Calculate the new meter variable as:

$$METER_VAR_{new} = METER_VAR_{old} * \frac{\text{Reference Reading}}{\text{TCE 8000 Reading}}$$

If you made several test runs, use the average meter variable.

Use the keys “RIGHT” and “UP” to set the calculated meter variable and confirm with “P” or skip with “EXIT”.

The display returns to the “SERVICE - CALIBRATION” menu.



6.4.5. Recalibration

KEM Küppers Elektromechanik GmbH and AW-Lake Company offers to recalibrate the sensor in Germany or the USA. The following calibration types are offered as standard according to configuration:

- Standard calibration
- Customer specified calibration
- Calibrations according DIN EN ISO/IEC 17025:2005
- Density calibration
- Witness calibration

6.5. Cleaning

Cleaning the enclosure

- Clean the outside of the enclosure with the inscriptions and the display window using a cloth moistened with water or a mild detergent.
- Do not use any aggressive cleansing agents or solvents, e.g. acetone. Plastic parts or the painted surface could be damaged. The inscriptions could become unreadable.

6.6. Service

Apart from the fuses the TCE 8000 does not contain any user serviceable parts.

In case of malfunction, please contact your nearest dealer or directly KEM Küppers Elektromechanik GmbH.

For the addresses see back of the manual.

Service information is information about the condition of the device used for diagnostics and service purposes.

The basic service information parameters are:

- Driver Current
- Pickup 1 Amplitude
- Pickup 2 Amplitude
- Sensor Frequency
- Frame Temperature
- Process Media Temperature
- Zero Point Adjustment Auto/Manual
- Zero Point Offset Value
- Manual Zero Point
- Zero Point Standard Deviation

6.7. Global Device Password

In order to protect the TRICOR CLASSIC Mass Flow Meter from unauthorized access, a user-specific password can be set. It protects the access to all configuration menus. The password can be set either through the local display as described below or through the Modbus interface (see TRICOR CLASSIC Modbus RTU manual).

NOTE:

If the global access code gets lost, the meter must be returned to KEM/AWL for resetting it. Resetting the code onsite is not possible!

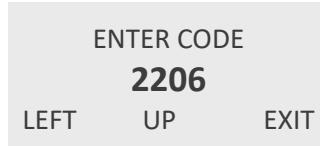
Press "P" for about three seconds. The display shows



Use the key "UP" or "DOWN" to select



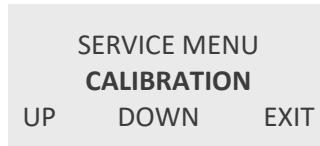
Press "P". The display shows



Change the indicated number with "LEFT" and "UP" to "2208" and confirm with "P".

If a wrong code is entered, the display shows "ERROR" for about two seconds and then asks for a new input.

When the correct code is entered the display shows

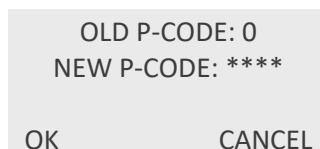


Use the key "UP" or "DOWN" to select ACCESS CODE and confirm with "P" or skip with "EXIT"



Change the indicated number with "LEFT" and "UP" to the desired code number and confirm with "P".

The display shows



Confirm with "OK" or skip with "CANCEL".

Write down the access code.

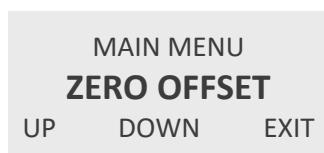
The display returns to the "SERVICE - ACCESS CODE" menu.



6.8. Reloading Factory Settings

In case the TCM has been completely misadjusted for any reason, the TCM can be reset to the original settings ex works.

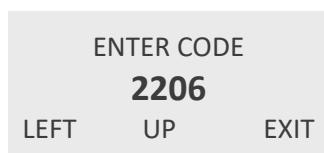
Press "P" for about three seconds. The display shows



Use the key "UP" or "DOWN" to select



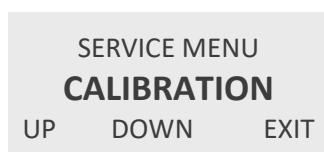
Press "P". The display shows



Change the indicated number with "LEFT" and "UP" to "2208" and confirm with "P".

If a wrong code is entered, the display shows "ERROR" for about two seconds and then asks for a new input.

When the correct code is entered the display shows



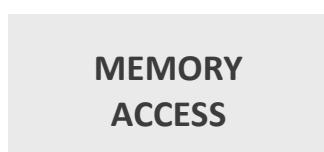
Use the key "UP" or "DOWN" to select RECALL FACT and confirm with "P" or skip with "EXIT".

The display shows



Start the recall process with "START" or skip with "EXIT".

If "START" is pressed, the display shows for some seconds



After that for about two seconds



READY

The display returns to the “RECALL FACTORY” menu.

7. Listings

7.1. Warranty

For warranty refer to the general terms and conditions of KEM Küppers Elektromechanik GmbH, which can be found on the corresponding website (www.kem-kueppers.com), respectively for the Americas those of AW Lake Company (www.aw-lake.com).

7.2. Certifications and Compliances

| Category | Standards or description | |
|--|--|--|
| EU Declaration of Conformity - EMC | Meets intent of Directive 2014/30/EU for Electromagnetic Compatibility. Compliance is given to the following specifications as listed in the Official Journal of the European Union: | |
| | EN 61326/2006 | EMC requirements for Class A electrical equipment for measurement, control and laboratory use, including Class A radiated and Conducted Emissions ¹⁶⁾ and Immunity ¹⁶⁾ . |
| | IEC 61000-4-2/2009 | Electrostatic Discharge Immunity (Performance criterion B) |
| | IEC 61000-4-3/2011 | Radiated RF Electromagnetic Field Immunity (Performance criterion B) |
| | IEC 61000-4-4/A1-2013 | Electrical Fast Transient/Burst Immunity (Performance criterion B) |
| | IEC 61000-4-5/2015 ¹⁷⁾ | Power Line Surge Immunity (Performance criterion B) |
| | IEC 61000-4-6/2014 | Conducted RF Immunity (Performance criterion B) |
| | IEC 61000-4-11/2005 ¹⁷⁾ | Voltage Dips and Interruptions Immunity (Performance criterion B) |
| Australia/New Zealand Declaration of Conformity- EMC | Complies with the EMC Emission standard ¹⁶⁾ | |
| | AS/NZS 2064 | |
| FCC EMC Compliance | Emissions comply with the Class A Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B ¹⁶⁾ . | |

¹⁶⁾ Compliance demonstrated using high-quality shielded interface cables.

¹⁷⁾ Applies only to units with AC mains supply instead of or additional to the SELV supply.

| Category | Standards or description | |
|---|---|---|
| EU Declaration of Conformity – Low Voltage | Compliance is given to the following specification as listed in the Official Journal of the European Union: Low Voltage Directive 2014/35/EU | |
| | EN 61010-1/2010 | Safety requirements for electrical equipment for measurement control and laboratory use. |
| Designed to meet the following US standards | UL 61010-1/2012 | Standard for electrical measuring and test equipment. |
| Designed to meet the following Canadian standards | CAN/CSA C22.2 no. 61010-1-4/2008 | Safety requirements for electrical equipment for measurement, control, and laboratory use. |
| International standards | IEC61010-1/2010 | Safety requirements for electrical equipment for measurement, control, and laboratory use. |
| Equipment Type | Test and measuring | |
| Safety Class | Class 1 (as defined in IEC 61010-1, Annex H) – grounded product | |
| ATEX IECEx | II 2G Ex d [ia] IIC T2...T4 Gb Ex d [ia] IIC T2...T4 Gb | TCE 800*-W(I)-****-Ex |
| | II 2G Ex d [ia] IIC T2...T4 Gb Ex d [ia] IIC T2...T4 Gb | TCMx 0325...7900-**-****-C***-Ex |
| | II 2G Ex d [ia] IIB T2...T4 Gb Ex d [ia] IIB T2...T4 Gb | TCE 801*-W(I)-****-Ex |
| | II 2G Ex d [ia] IIB T2...T4 Gb Ex d [ia] IIB T2...T4 Gb | TCM 028K...065K-**-****-C***-Ex |
| | II 2G Ex ia IIC T2...T4 Gb Ex ia IIC T2...T4 Gb | TCMx 0325...7900-*-*-*-****-Ex TCMx 0325...7900-*-*-*-****-Ex3 |
| | II 2G Ex ia IIB T2...T4 Gb Ex ia IIB T2...T4 Gb | TCMx 028K...230K-*-*-*-****-Ex (TCMx 230K : only with remote electronics) TCMx 028K...230K-*-*-*-****-Ex3 |
| ATEX | II 3G Ex nA IIC T2...T4 Gc | TCE 800*-W-****-Exn TCMx *-*-*-*-****-Exn |
| cCSAus | Class I, Division 1 Group A, B, C, D, T2...T4 | TCE 800*-W-****-Ex1 TCE 800*-W-****-Ex3 TCMx 0325...7900-*-*-*-****-Ex1 |
| | Class I, Division 1 Group A, B, C, D, T2...T4 | TCMx 0325...7900-**-****-C***-Ex1 |
| | Class I, Division 1 Group C, D, T2...T4 | TCE 801*-W-****-Ex1 TCE 801*-W-****-Ex3 TCMx 028K...230K-*-*-*-****-Ex1 |
| | Class I, Division 1 Group C, D, T2...T4 | TCMx 028K...230K-*-*-*-****-C***-Ex1 (TCMx 230K: only with remote electronics) |

Ex3: only with remote transmitter.

For Ex1 and Ex3 the transmitter is only available in aluminum housing.



7.3. Technical Data

7.3.1. TCM Transducer – Technical Data for Liquids

| | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K | | | | |
|---------------------------------|--|-------------|-------------|-------------|---|-------------|-------------|-------------|---------------------------------|--|--|--|--|
| Max. Flow Rate (kg/h) | 325 | 650 | 1,550 | 3,100 | 5,500 | 7,900 | 28,000 | 65,000 | 230,000 | | | | |
| Max. Flow Rate (lb/min) | 12 | 24 | 57 | 114 | 202 | 290 | 1,029 | 2,388 | 8,450 | | | | |
| Basic Accuracy (Mass Flow) | $\pm 0.3\%$ of flow rate (option: up to 0.1 % of flow rate) | | | | | | | | $\pm 0.3\%$ ($\pm 0.15\%$) | | | | |
| Basic Accuracy (Volume Flow) | $\pm 0.3\%$ of flow rate (option: up to 0.15 % of flow rate) | | | | | | | | $\pm 0.3\%$ ($\pm 0.2\%$) | | | | |
| Basic Accuracy (Mass Flow) | $\pm 0.3\%$ of flow rate (option: up to 0.15 % of flow rate) | | | | | | | | | | | | |
| Basic Accuracy (Volume Flow) | $\pm 0.6\%$ of flow rate (option: up to 0.2 % of flow rate) | | | | | | | | | | | | |
| Repeatability | $\pm 0.05\%$ of flow rate | | | | | | | | | | | | |
| Zero Stability | $\pm 0.01\%$ of full scale | | | | | | | | $\pm 0.015\%$ | | | | |
| Density Range | up to 2,500 kg/m ³ [2.5 g/cm ³] (higher ranges on request) | | | | | | | | | | | | |
| Density Accuracy | $\pm 1.0\text{ kg/m}^3$ [$\pm 0.001\text{ g/cm}^3$] | | | | | | | | | | | | |
| Density Repeatability | $\pm 0.5\text{ kg/m}^3$, $\pm 0.0005\text{ g/cm}^3$ | | | | | | | | | | | | |
| Process Temperature Range | $\pm 1\text{ }^\circ\text{C} \pm 0.5\%$ of reading [$\pm 1.8\text{ }^\circ\text{F} \pm 0.5\%$ of reading] | | | | | | | | | | | | |
| Temperature Repeatability | $\pm 0.2\text{ }^\circ\text{C}$ [$\pm 0.36\text{ }^\circ\text{F}$] | | | | | | | | | | | | |
| Process and Ambient | | | | | | | | | | | | | |
| Process Connections | female thread $\frac{1}{2}$ " adaptors for flanges, dairy and tri-clamp | | | | flanges EN1092, ANSI B16.5, DIN2512 treated tri-clamp | | | | | | | | |
| Max. Pressure Standard | 200 bar [2,900 psi] option: up to 345 bar [5,000 psi] (not for ASME) | | | | 100 bar [1,450 psi] | | | | | | | | |
| Pressure Drop at max. Flow | for detail information please contact us | | | | | | | | | | | | |
| Process Temperature (non Ex) | $-40\text{ }^\circ\text{C} \dots +100\text{ }^\circ\text{C}$ [-40 °F ... +212 °F] (standard) $-40\text{ }^\circ\text{C} \dots +150\text{ }^\circ\text{C}$ [-40 °F ... +302 °F] (option) $-60\text{ }^\circ\text{C} \dots +200\text{ }^\circ\text{C}$ [-76 °F ... +392 °F] (option) | | | | | | | | | | | | |
| Process Temperature (Ex) | meter mount | | | | $-40\text{ }^\circ\text{C} \dots +70\text{ }^\circ\text{C}$ [-40 °F ... +158 °F] (T4) | | | | n/a | | | | |
| | remote version | | | | $-40\text{ }^\circ\text{C} \dots +70\text{ }^\circ\text{C}$ [-40 °F ... +158 °F] (T4) $-40\text{ }^\circ\text{C} \dots +135\text{ }^\circ\text{C}$ [-40 °F ... +275 °F] (T3) $-60\text{ }^\circ\text{C} \dots +200\text{ }^\circ\text{C}$ [-76 °F ... +392 °F] (T2) | | | | | | | | |
| Ambient Temperature | $-40\text{ }^\circ\text{C} \dots +70\text{ }^\circ\text{C}$ [-40 °F ... +158 °F] | | | | | | | | | | | | |
| Storage Temperature | $-40\text{ }^\circ\text{C} \dots +100\text{ }^\circ\text{C}$ [-40 °F ... +212 °F] | | | | | | | | | | | | |
| Electr. Connections Remote | screw type terminals | | | | | | | | | | | | |
| Electr. Connections Meter Mount | none (internally connected to the electronics) | | | | | | | | | | | | |
| Ingress Protection | IP65 (IP66/IP67 on request) | | | | | | | | | | | | |
| General | | | | | | | | | | | | | |
| Tube Arrangement | 2 serial | 2 parallel | 2 serial | 2 parallel | 2 parallel | 2 parallel | 2 parallel | 2 parallel | 2 parallel | | | | |
| Tube Inner Diameter | 4 mm | 4 mm | 8 mm | 8 mm | 7 mm | 9 mm | 16 mm | 28 mm | 43 mm | | | | |
| Tube Material | 1.4404 [AISI 316L] | | | | | | | | | | | | |
| Housing Material | 1.4404 [AISI 316L] | | | | | | | | | | | | |
| Dimensions | see dimensional drawings chapter 7.3.7 | | | | | | | | | | | | |

Calibration for Liquids and Gases: The TRICOR CLASSIC flowmeters are always factory calibrated with water.

Calibration Conditions: Water: 20 °C ... 25 °C [68 °F ... 77 °F], ambient temperature: 20 °C ... 25 °C [68 °F ... 77 °F].

All specifications are based on above mentioned calibration reference conditions, a flow calibration protocol is attached to each instrument.

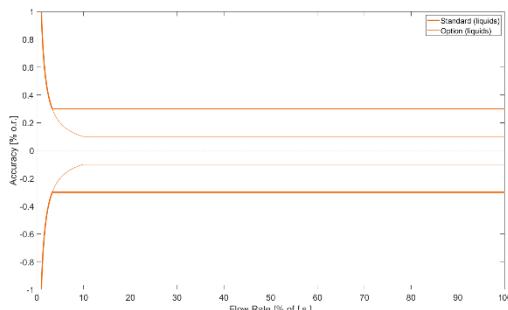
Stated accuracy combines the effects of repeatability, linearity and hysteresis.

Typical flow dynamics based on max. flow rate is 100:1.

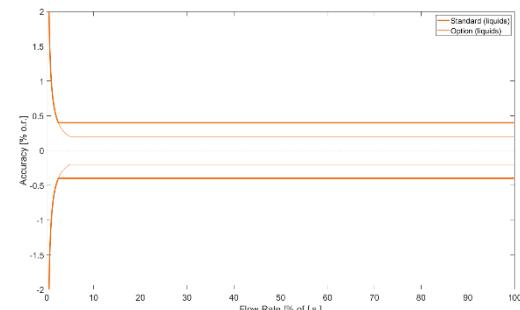
7.3.2. Accuracy for Liquids

7.3.2.1. TCM 0325 to TCM 065K

Mass Flow

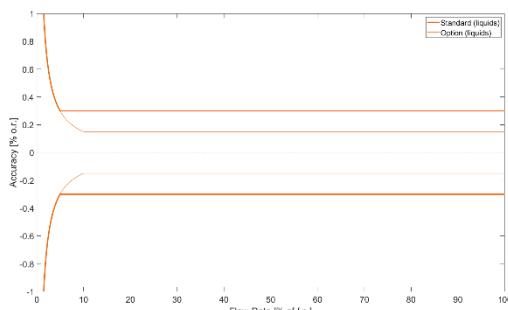


Volume Flow

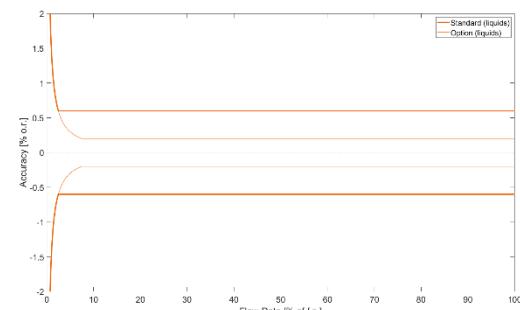


7.3.2.2. TCM 230K

Mass Flow



Volume Flow



| Flow Rate of full Scale | Accuracy |
|--|---|
| $\geq \frac{\text{Zero Point}}{\text{Basic Accuracy}} * 100$ | $\pm \text{Basic Accuracy}$ |
| $< \frac{\text{Zero Point}}{\text{Basic Accuracy}} * 100$ | $\pm \frac{\text{Zero Point}}{\text{Measured Value}} * 100$ |



7.3.3. TCM Transducer – Technical Data for Gases

| | TCM 0325 | TCM 0650 | TCM 1550 | TCM 3100 | TCM 5500 | TCM 7900 | TCM 028K | TCM 065K | TCM 230K | | | |
|--|--|-------------------|-------------------|------------------|-----------------|--|---------------------|----------------|---------------|--|--|--|
| Nom. Flow Rate (kg/h) ^{18) 20)} | 78 | 177 | 333 | 740 | 910 | 1,430 | 5,100 | 15,650 | 48,900 | | | |
| Nom. Flow Rate (lb/min) ^{18) 20)} | 3 | 7 | 12 | 27 | 34 | 53 | 188 | 575 | 1,797 | | | |
| Nom. Flow Rate (Nm ³ /h) ^{18) 19)} | 109 | 247 | 464 | 1,031 | 1,268 | 1,993 | 7,109 | 21,813 | 68,157 | | | |
| Nom. Flow Rate (SCFM) ^{18) 19)} | 64 | 146 | 273 | 607 | 747 | 1,173 | 4,184 | 12,838 | 40,115 | | | |
| Basic Accuracy | $\pm 1\%$ of flow rate (option: up to $\pm 0.5\%$ of flow rate) | | | | | | | | | | | |
| Repeatability | $\pm 0.25\%$ of flow rate | | | | | | | | | | | |
| Zero Stability in kg/h [lb/min] | 0.0325 [0.0012] | 0.065 [0.0024] | 0.155 [0.0057] | 0.31 [0.0114] | 0.55 [0.020] | 0.79 [0.029] | 2.8 [0.103] | 6.5 [0.239] | 23 [0.845] | | | |
| Density Measuring Range | see comment ¹⁸⁾ | | | | | | | | | | | |
| Density Accuracy | $\pm 1.0\text{ kg/m}^3$ [$\pm 0.001\text{ g/cm}^3$] | | | | | | | | | | | |
| Density Repeatability | $\pm 0.5\text{ kg/m}^3$ [$\pm 0.0005\text{ g/cm}^3$] | | | | | | | | | | | |
| Process Temperature Range | $\pm 1\text{ }^\circ\text{C} \pm 0.5\%$ of reading [$\pm 1.8\text{ }^\circ\text{F} \pm 0.5\%$ of reading] | | | | | | | | | | | |
| Temperature Repeatability | $\pm 0.2\text{ }^\circ\text{C}$ [$\pm 0.36\text{ }^\circ\text{F}$] | | | | | | | | | | | |
| Process and Ambient | | | | | | | | | | | | |
| Process Connections | female thread $\frac{1}{2}$ " adaptors for flanges, dairy and tri-clamp | | | | | flanges EN1092, ANSI B16.5, DIN2512 treated tri-clamp | | | | | | |
| Max. Pressure Standard (Option) | 200 bar [2,900 psi] option: up to 345 bar [5,000 psi] (not for ASME) | | | | | | 100 bar [1,450 psi] | | | | | |
| Pressure Drop at Max. Flow | for detail information please contact us | | | | | | | | | | | |
| Process Temperature (non Ex) | $-40\text{ }^\circ\text{C} \dots +100\text{ }^\circ\text{C}$ [-40 °F ... +212 °F] (standard) $-40\text{ }^\circ\text{C} \dots +150\text{ }^\circ\text{C}$ [-40 °F ... +302 °F] (option) $-60\text{ }^\circ\text{C} \dots +200\text{ }^\circ\text{C}$ [-76 °F ... +392 °F] (option) | | | | | | | | | | | |
| Process Temperature (Ex) | meter mount $-40\text{ }^\circ\text{C} \dots +70\text{ }^\circ\text{C}$ [-40 °F ... +158 °F] (T4) | | | | | | | n/a | | | | |
| | remote version $-40\text{ }^\circ\text{C} \dots +70\text{ }^\circ\text{C}$ [-40 °F ... +158 °F] (T4) $-40\text{ }^\circ\text{C} \dots +135\text{ }^\circ\text{C}$ [-40 °F ... +275 °F] (T3) $-60\text{ }^\circ\text{C} \dots +200\text{ }^\circ\text{C}$ [-76 °F ... +392 °F] (T2) | | | | | | | | | | | |
| Ambient Temperature | $-40\text{ }^\circ\text{C} \dots +70\text{ }^\circ\text{C}$ [-40 °F ... +158 °F] | | | | | | | | | | | |
| Storage Temperature | $-40\text{ }^\circ\text{C} \dots +100\text{ }^\circ\text{C}$ [-40 °F ... +212 °F] | | | | | | | | | | | |
| Electr. Connections Remote | screw type terminals | | | | | | | | | | | |
| Electr. Connections Meter Mount | none (internally connected to the electronics) | | | | | | | | | | | |
| Ingress Protection | IP65 (IP66/IP67 on request) | | | | | | | | | | | |
| General | | | | | | | | | | | | |
| Tube Arrangement | 2 serial | 2 parallel | 2 serial | 2 parallel | 2 parallel | 2 parallel | 2 parallel | 2 parallel | 2 parallel | | | |
| Tube Inner Diameter | 4 mm | 4 mm | 8 mm | 8 mm | 7 mm | 9 mm | 16 mm | 28 mm | 43 mm | | | |
| Tube Material | 1.4404 [AISI 316L] | | | | | | | | | | | |
| Housing Material | 1.4404 [AISI 316L] | | | | | | | | | | | |
| Dimensions | see chapter 7.3.7 | | | | | | | | | | | |

Max. allowed flow velocity (Ma 0.5).

For gas applications, flow rate and pressure drop for individual sensor sizes are dependent on operating temperature, pressure and fluid composition.

Therefore, when selecting a sensor for any particular gas application, please use the the TSP (TRICOR Sizing Program) or contact us.

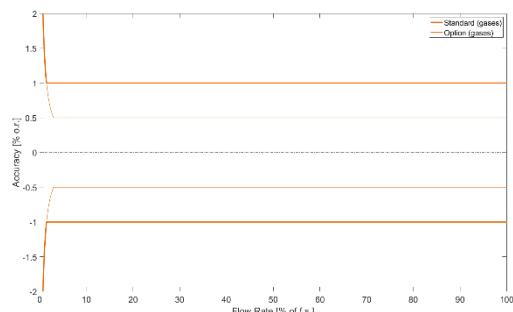
¹⁸⁾ Nominal flow rates that produce approximately 3 bar [43 psi] pressure drop for natural gas at 50 bar [725 psi] operational pressure.

¹⁹⁾ Normal reference conditions (Nm³/h) are 1,013 bar und 0 °C. Standard (SCFM) reference conditions are 14.7 psi und 60 °F.

²⁰⁾ Flow rate and density range depend on the gas density and the pressure range.

7.3.4. Accuracy for Gases

Mass Flow



| Flow Rate of full Scale | Accuracy |
|--|---|
| $\geq \frac{\text{Zero Point}}{\text{Basic Accuracy}} * 100$ | $\pm \text{Basic Accuracy}$ |
| $< \frac{\text{Zero Point}}{\text{Basic Accuracy}} * 100$ | $\pm \frac{\text{Zero Point}}{\text{Measured Value}} * 100$ |



7.3.5. Technical Data TCE 8000/8100 Transmitter

| General | |
|---|--|
| Supply Voltage | 24 V DC or 100 ... 240 V AC (version dependent) |
| Power Consumption | max. 4 W (DC version) max. 11 W (AC version) |
| Environmental Conditions | <ul style="list-style-type: none"> Transient over voltages up to the levels of overvoltage category II Temporary over voltages occurring on mains supply only POLLUTION DEGREE 2 MAINS AC supply voltage fluctuations up to $\pm 10\%$ of the nominal voltage Altitude up to 2,000 m |
| Reverse Polarity Protection | yes |
| Galvanic Isolation | 2,500 V AC |
| Display | back-lit LCD screen, 132 x 32 dot |
| Programming | via front keyboard or Windows-based TRICOR configurator program (Modbus) |
| Interfaces | RS485 (Modbus RTU), Option HART®, Foundation Fieldbus® other options on request |
| Cable Glands | Suitable for Ø 7 - 13 mm cables Material: Brass/Ni plated (option: Stainless steel 1.4404 [AISI 316]) Thread: 2 x $\frac{1}{2}$ " NPT or 2 x M20 x 1.5 |
| ExD Housing: Wall-mounted | |
| Dimensions | see chapter 7.3.7 |
| Electrical Connections | cage clamp terminals |
| Sensor Cable Glands | Barrier cable gland: applied by manufacturer (thread: $\frac{1}{2}$ " NPT) |
| Housing Material | Aluminum diecast (option: 1.4404 [AISI 316L]) |
| Protection class | IP65 (IP66/IP67 on request) |
| Weight: | with aluminum diecast housing: 3.8 kg [8.3 lb] with 3 m cable with 1.4404 [AISI 316L] housing: 6.15 kg [13.56 lb] |
| Temperature | ambient: -40 °C ... +70 °C [-40 °F ... +158 °F] storage and transport: -40 °C ... +80 °C [-40 °F ... +176 °F] |
| Housing: Panel-mounted (only TCE 8000) | |
| Dimensions | see chapter 7.3.7 |
| Electrical Connections | cage clamp terminals |
| Housing Material | Noryl |
| Protection Class | front: IP50, rear: IP30 |
| Weight | 0.4 kg [0.88 lb] |
| Temperature | ambient: ± 0 °C ... +60 °C [32 °F ... +140 °F] storage and transport: -20 °C ... +70 °C [-4 °F ... +158 °F] |
| Analog Outputs | |
| Current Outputs (2x) | 4 ... 20 mA passive, two-wire, isolated |
| Resolution | 14 bit |
| Linearity | $\pm 0.05\%$ of full scale |
| Temperature Drift | 0.05 % per 10 K |
| Load | < 620 Ω (at 24 V supply) |
| Output Value | programmable: flow, total, density, temperature |
| Pulse Output | |
| Frequency Range | 0.5 - 10,000 Hz (in TOTAL mode: 0 - 100 Hz) |
| Output Signal | active push pull output for flow rate |

| Status In- and Output | |
|-----------------------|--|
| Status Output | push pull programmable (in FREQUENCY mode: 0.5 - 10,000 Hz) |
| Control Input | programmable |
| Analog Input (option) | |
| Input Type | 4 ... 20 mA active for two-wire passive pressure sensor |
| Resolution | 12 bit |
| Linearity | ±0.05 % of full scale |
| Temperature Drift | 0.05 % per 10 K |
| Supply Voltage | > 20 V (at 20 mA sensor current) |

7.3.6. Technical Data TCE/TCM Cable

| | Standard cable | High temperature cable |
|-----------------------|--|---|
| General | | |
| Outer Diameter | 8.30 mm ±0.2 mm | 6,9 mm ±0,2 mm |
| Sheath | PUR (DIN VDE 0207 UL Style 20233) | FEP |
| Colour | blue (similar RAL5002 matt) | black |
| Labeling | UL (white) | — |
| RoHS | yes | yes |
| Resistance | | |
| Halogen-free | halogen-free (IEC 60754-2) | — |
| Flammability | flame-retardant (IEC 60332-1-2 (VDE 0472 Part 804 B) | flame-retardant |
| Hydrolysis Resistance | hydrolysis resistance | — |
| Oil Resistance | oil resistance (DIN EN 60811-2-1) | oil resistance |
| Laying | | |
| Range of Temperatures | moved: -30 °C to +80 °C (UL) [-22 °F to +176 °F (UL)] fixed: -50 °C to +80 °C (UL) [-58 °F to +176 °F (UL)] | -85 °F up to +356 °F [-65 °C up to +180 °C] |
| Bending Radius | moved: 85 mm (10xD) fixed: 42.5 mm (5xD) | moved: 71 mm (10xD) fixed: 35.5 mm (5xD) |

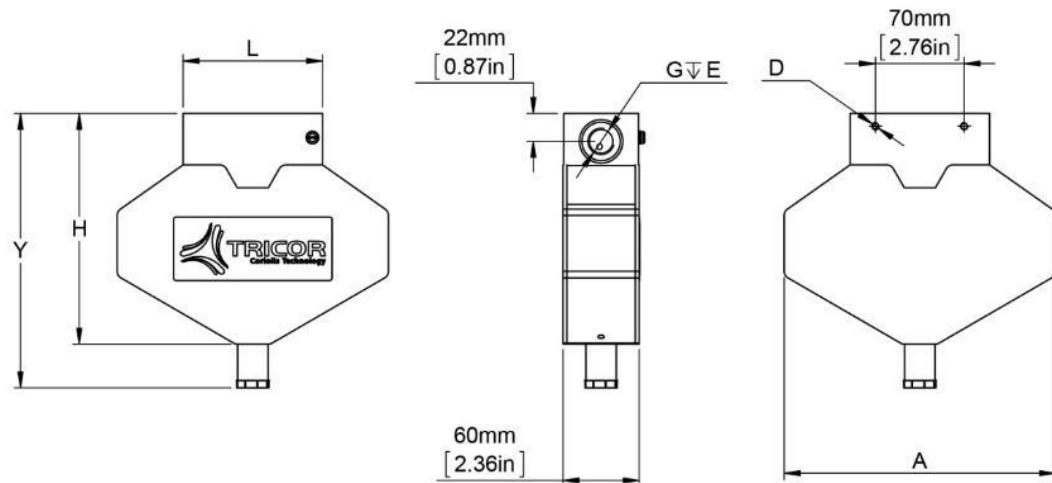
7.3.7. Torque requirements

| Description | Torque |
|--|--------|
| Cable gland to housing | 10 Nm |
| Enclosure lids | 10 Nm |
| Wall bracket screws | 10 Nm |
| Transmitter pedestal lock screw (compact version and remote version) | 10 Nm |



7.3.8. Dimensional Drawings

Dimensional Drawing Sensors TCM 0325 to TCM 0650



| Sensor Type | A | D | E | G ²¹⁾ | H | L ²²⁾ | Y |
|-------------|---------------------|---------|--------------------|------------------|---------------------|---------------------|---------------------|
| TCM 0325 | 214 mm [8.43 in] | M6 ↓ 10 | 15 mm [0.59 in] | G ½" | 182 mm [7.17 in] | 110 mm [4.33 in] | 216 mm [8.50 in] |
| TCM 0650 | 214 mm [8.43 in] | M6 ↓ 10 | 15 mm [0.59 in] | G ½" | 182 mm [7.17 in] | 110 mm [4.33 in] | 216 mm [8.50 in] |

Fig. 25: Dimensions TCM 0325-***-***** through TCM 0650-***-*****

Dimensional Drawing Sensor TCMH 0450

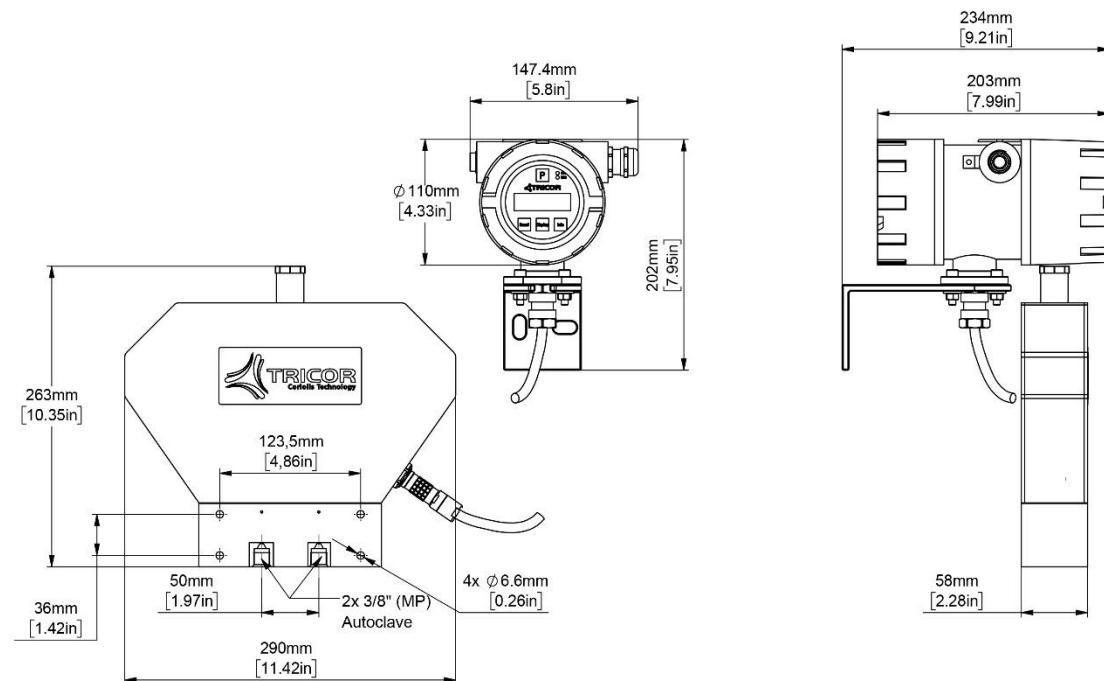


Fig. 26: Meter Dimensions TCMH 0450, Ex/Ex1

²¹⁾ Other connections on request.

²²⁾ Further lengths on request.

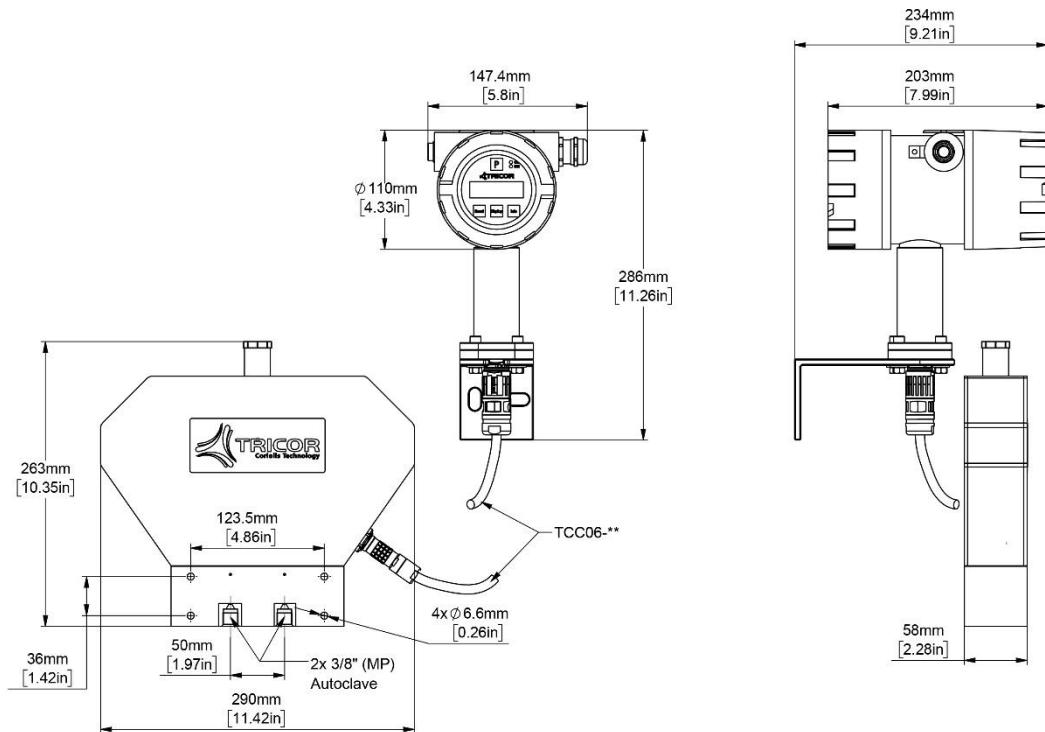
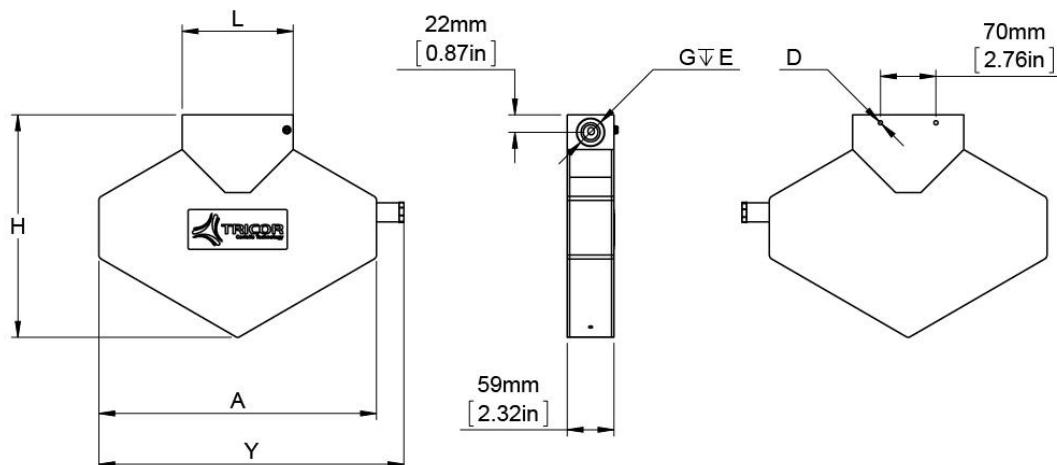


Fig. 27: Meter Dimensions TCMH 0450, Ex3

Dimensional Drawing Sensors TCM 1550 to TCM 3100

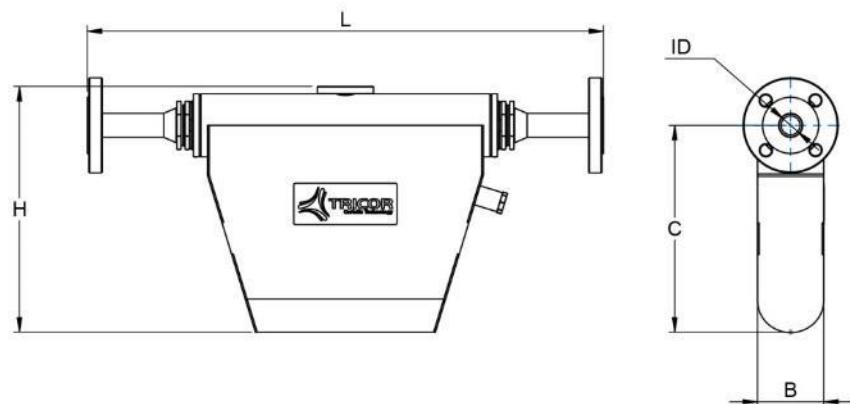


| Sensor Type | A | D | E | G ²³⁾ | H | L ²⁴⁾ | Y |
|-------------|----------------------|---------|--------------------|------------------|----------------------|---------------------|----------------------|
| TCM 1550 | 350 mm [13.78 in] | M6 ↓ 10 | 18 mm [0.71 in] | G ½" | 280 mm [11.02 in] | 140 mm [5.51 in] | 384 mm [15.12 in] |
| TCM 3100 | 350 mm [13.78 in] | M6 ↓ 10 | 18 mm [0.71 in] | G ½" | 280 mm [11.02 in] | 140 mm [5.51 in] | 384 mm [15.12 in] |

Fig. 28: Dimensions TCM 1550-**-****-**** through TCM 3100-**-****-****



Dimensional Drawing Sensors TCM 5500 to TCM 065K



| Sensor Type | B | C | H | L ²⁴⁾ | I.D. | Connection ²³⁾ |
|----------------|---------------------|----------------------|----------------------|----------------------|------------------------|---------------------------|
| TCM 5500, 7900 | 61 mm [2.40 in] | 204 mm [8.03 in] | 260 mm [10.24 in] | 460 mm [18.11 in] | Ø 13 mm [Ø 0.51 in] | on request |
| TCM 028K | 80 mm [3.15 in] | 253 mm [9.96 in] | 315 mm [12.40 in] | 625 mm [24.61 in] | Ø 23 mm [Ø 0.91 in] | on request |
| TCM 065K | 151 mm [5.94 in] | 387 mm [15.24 in] | 480 mm [18.90 in] | 830 mm [32.68 in] | Ø 40 mm [Ø 1.57 in] | on request |

Fig. 29: Dimensions TCM 5500-***-****-**** through TCM 065K-***-****-***

Dimensional Drawing Sensors TCM 230K

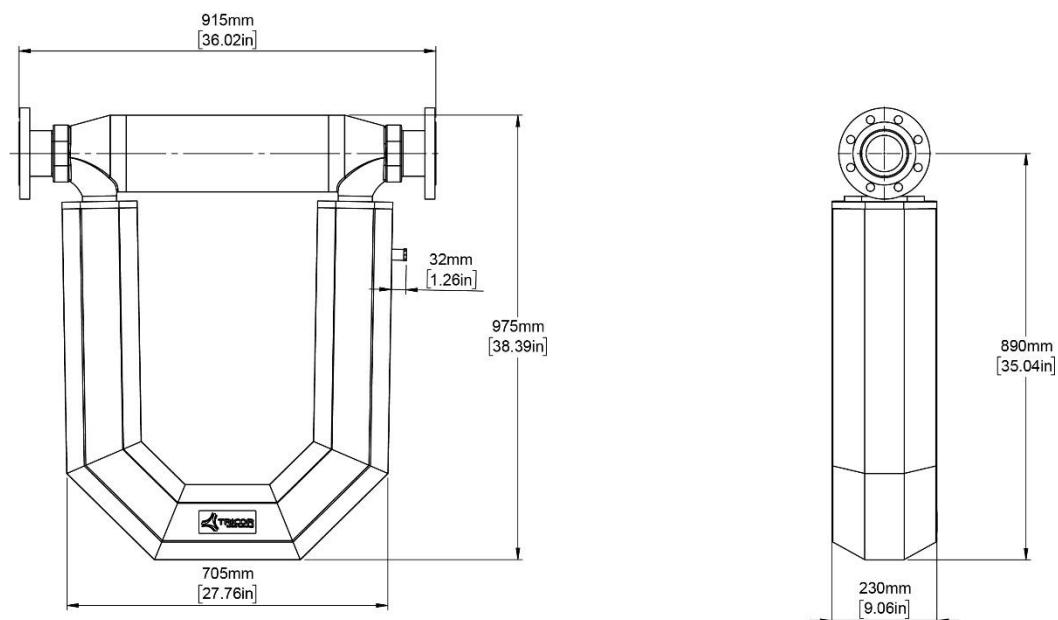


Fig. 30: Dimensions TCM 230K-***-****-***

²³⁾ Other connections on request.

²⁴⁾ Further lengths on request.

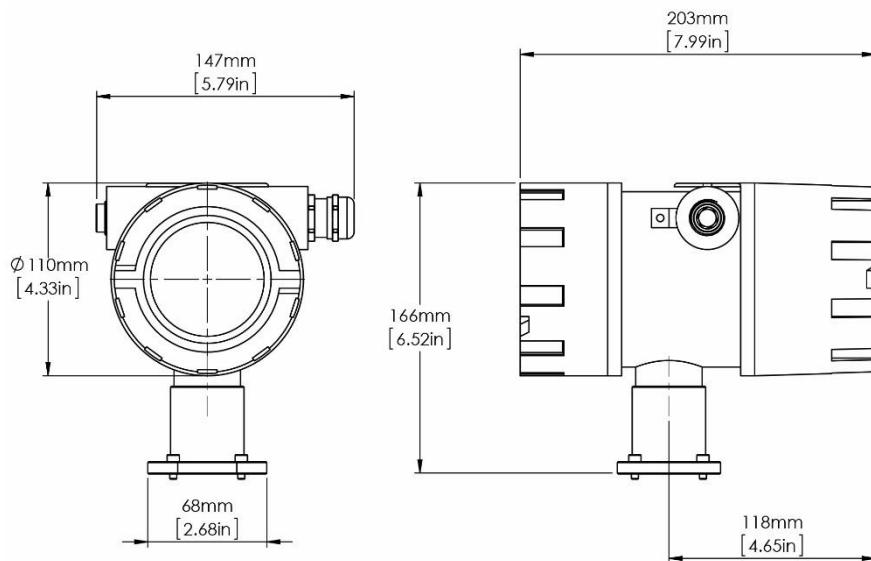
Dimensional Drawing Meter-Mount Transmitter TCE 8000/8100

Fig. 31: Dimensions compact transmitter TCE 8000/8100

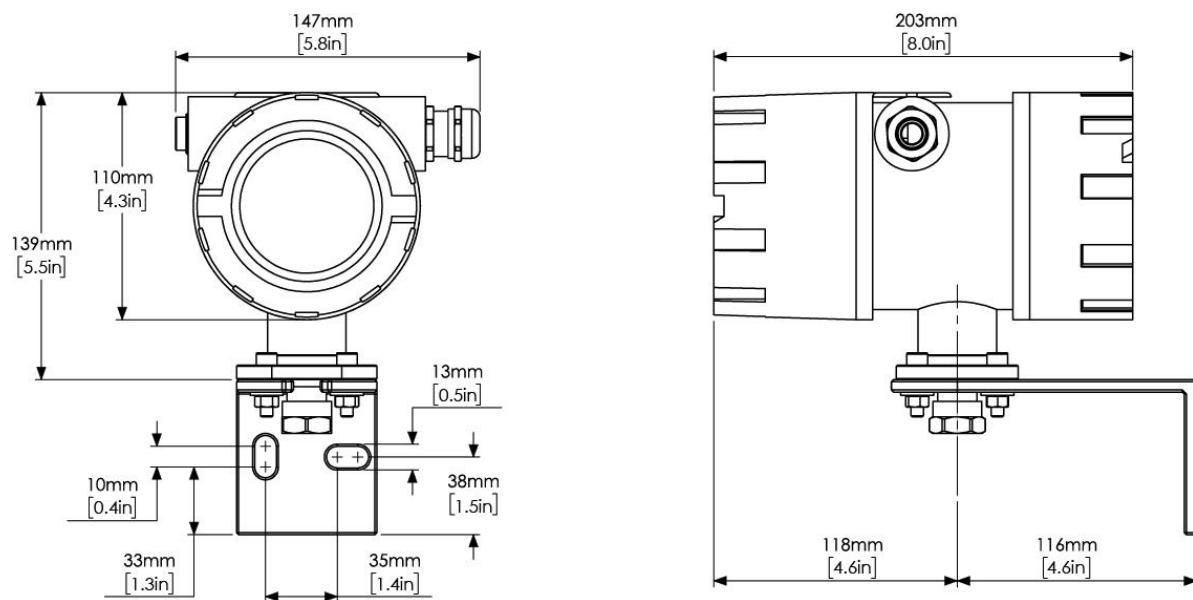
Dimensional Drawing Wall-Mount Transmitter TCE 8000/8100

Fig. 32: Dimensions Wall-Mount Transmitter TCE 8000/8100



Dimensional Drawing Meter-Mount Transmitter TCE 8000/8100 with blind cover

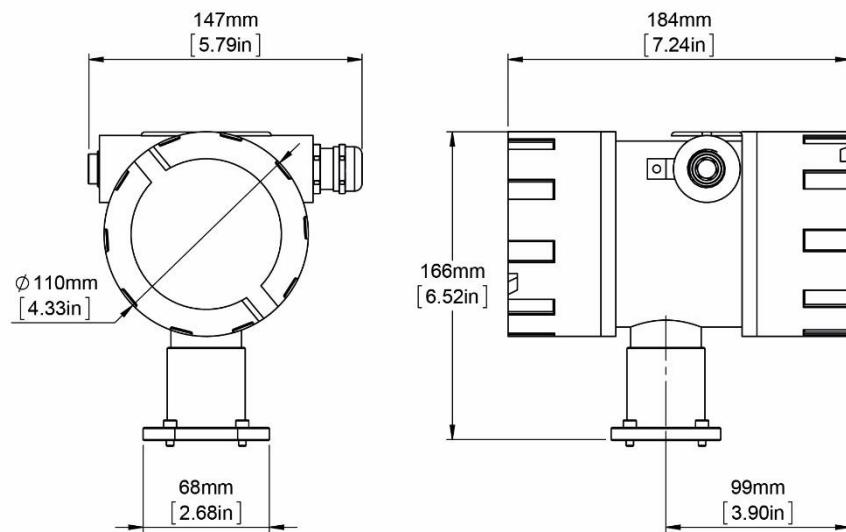


Fig. 33: Dimensions Meter-Mount Transmitter TCE 8000/8100 with blind cover

Dimensional Drawing Meter-Mount Transmitter TCE 8000/8100 High Temperature

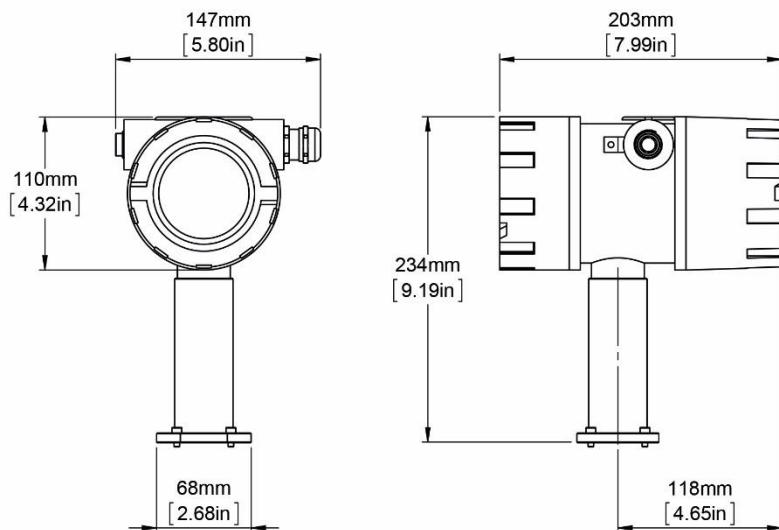
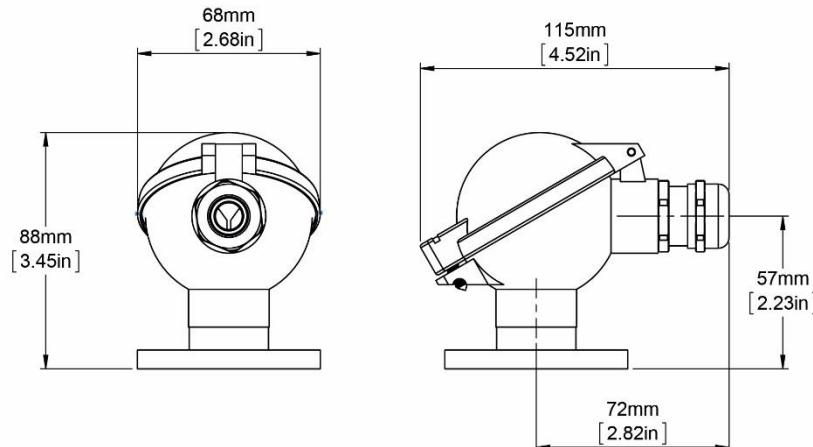


Fig. 34: Dimensions Meter-Mount Transmitter TCE 8000/8100 High Temperature

Dimensional Drawing Connection head



Dimensional Drawing High Temperature Connection Head

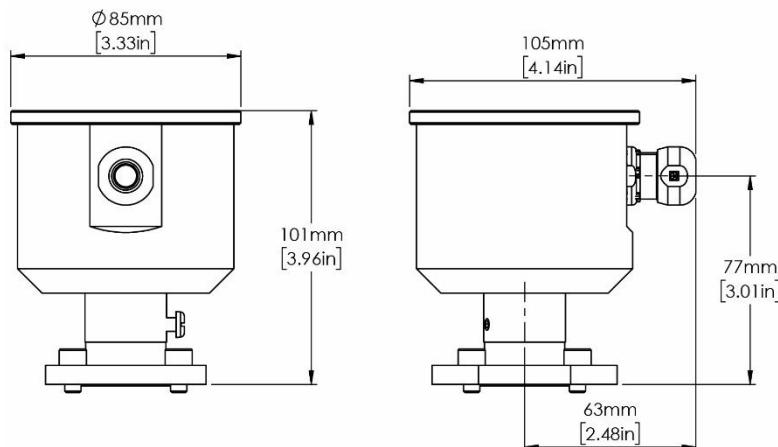
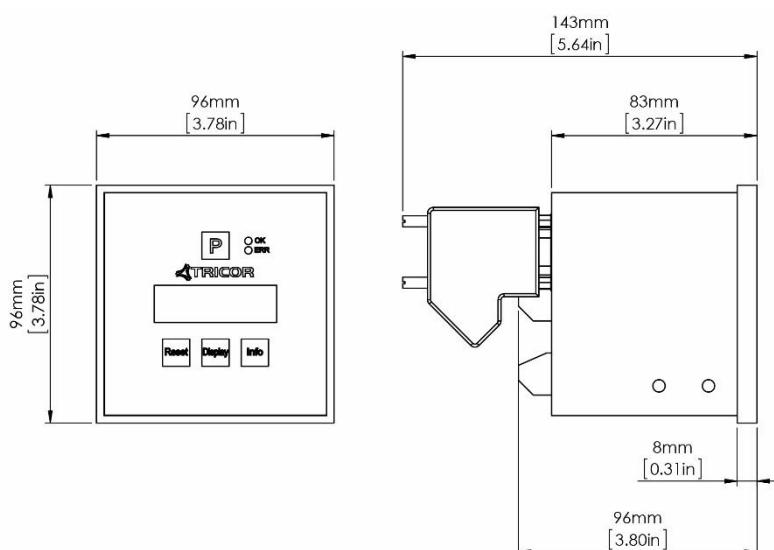


Fig. 35: Dimensions Connection head

Dimensional Drawing remote panel-mounted housings



The required cutout for the panel is 92 mm +0.8/-0 mm x 92 mm +0.8/-0 mm.

The maximum thickness of the panel is 2 mm.

Fig. 36: Dimensions TCE 8***-S-***



7.4. WEEE and RoHS

The TRICOR CLASSIC Mass Flow Meter described herein is not subject to the WEEE directive and the corresponding national laws. At the end of life forward the TCM to a specialized recycling company and do not dispose it off as domestic waste.

The TCM described herein fully complies with the RoHS directive.

7.5. Menu Structure

7.5.1. Main Menu

In the following table only the menus and parameters of the first two levels of the HMI menu structure are listed.

| Level 1 | | Level 2 | | Mehr Informationen |
|---------|-------------|---------|--------------|---|
| No. | Name | No. | Name | |
| 1 | ZERO OFFSET | | | ZERO OFFSET Menu (Page 66) |
| 2 | DISPLAY | 2.1 | MASS TOTAL | DISPLAY - MASS TOTAL Menu (Page 67) |
| | | 2.2 | MASS FLOW | DISPLAY - MASS FLOW Menu (Page 68) |
| | | 2.3 | VOL. TOTAL | DISPLAY - VOL. TOTAL Menu (Page 70) |
| | | 2.4 | VOL. FLOW | DISPLAY - VOL. FLOW Menu (Page 71) |
| | | 2.5 | DENSITY | DISPLAY - DENSITY Menu (Page 72) |
| | | 2.6 | TEMPERATURE | DISPLAY - TEMPERATURE Menu (Page 73) |
| | | 2.7 | PRESSURE | DISPLAY - PRESSURE Menu (Page 74) |
| | | 2.8 | DISP MODE | DISPLAY - DISPLAY MODE Menu (Page 75) |
| 3 | SETUP | 3.1 | PARAMETER | SETUP - PARAMETER Menu (Page 78) |
| | | 3.2 | FILTER | SETUP - FILTER Menu (Page 84) |
| | | 3.3 | IN/OUTPUTS | SETUP - IN/OUTPUTS Menu (Page 85) |
| | | 3.4 | DATA CONFIG | SETUP - DATA CONFIGURATION Menu (Page 94) |
| | | 3.5 | RESET TOTAL | SETUP - RESET TOTAL Menu (Page 95) |
| | | 3.7 | CLEAR LOGS | SETUP - CLEAR LOGS Menu (Page 95) |
| 4 | I/O-TEST | 4.1 | FREQ OUT | I/O-TEST - FREQUENCY OUT Menu (Page 96) |
| | | 4.2 | CTRL OUT | I/O-TEST - CONTROL OUT Menu (Page 97) |
| | | 4.3 | mA-OUT | I/O-TEST - ANALOG OUT Menu (Page 97) |
| | | 4.4 | CTRL IN | I/O-TEST - CONTROL IN Menu (Page 98) |
| 5 | SERVICE | 5.1 | CALIBRATION | Calibration (Page 105) |
| | | 5.2 | ACCESS CODE | Global Device Password (Page 110) |
| | | 5.3 | RECALL FACT. | Reloading Factory Settings (Page 112) |

Tab. 8: Main menu

7.5.2. Menu Item „DISPLAY“

| Level 2 | | Level 3 | | Level 4 | |
|---------|-------------|---------|-------------|---------|-------------|
| No. | Name | No. | Name | No. | Name |
| 2.1 | MASS TOTAL | 2.1.1 | TOTAL UNITS | | |
| | | 2.1.2 | TOTAL DP | | |
| 2.2 | MASS FLOW | 2.2.1 | FLOW UNITS | | |
| | | 2.2.2 | FLOW DP | | |
| | | 2.2.3 | DISP FILTER | | |
| 2.3 | VOL. TOTAL | 2.3.1 | TOTAL UNITS | | |
| | | 2.3.2 | TOTAL DP | | |
| 2.4 | VOL. FLOW | 2.4.1 | FLOW UNITS | | |
| | | 2.4.2 | FLOW DP | | |
| | | 2.4.3 | DISP FILTER | | |
| 2.5 | DENSITY | 2.5.1 | TOTAL UNITS | | |
| | | 2.5.2 | TOTAL DP | | |
| 2.6 | TEMPERATURE | 2.6.1 | TEMP UNITS | | |
| | | 2.6.2 | TEMP DP | | |
| 2.7 | PRESSURE | 2.7.1 | PRESS.UNITS | | |
| | | 2.7.2 | PRESSURE DP | | |
| 2.8 | DISP MODE | 2.8.1 | DISPLAY 1 | 2.8.1.1 | SINGLE LINE |
| | | | | 2.8.1.2 | DUAL LINE |
| | | 2.8.2 | DISPLAY 1 | 2.8.2.1 | SINGLE LINE |
| | | | | 2.8.2.2 | DUAL LINE |
| | | 2.8.3 | BACKLIGHT | 2.8.3.1 | ON |
| | | | | 2.8.3.2 | OFF |
| | | 2.8.4 | TIME MODE | 2.8.4.1 | FIXED |
| | | | | 2.8.4.2 | ALTERNATE |

Tab. 9: Menu items “DISPLAY”

7.5.3. Menu Item „SETUP“

| Level 2 | | Level 3 | | Level 4 | |
|---------|------------|---------|-------------|---------|------|
| No. | Name | No. | Name | No. | Name |
| 3.1 | PARAMETER | 3.1.1 | METER MODE | | |
| | | 3.1.2 | CUT OFF | | |
| | | 3.1.3 | STEP RESP. | | |
| | | 3.1.4 | RESET KEY | | |
| | | 3.1.5 | FLOW-DIREC | | |
| | | 3.1.6 | K-FACTOR | | |
| | | 3.1.7 | FAULT TIME | | |
| | | 3.1.8 | PRESS.COMP. | | |
| | | 3.1.9 | TOTAL COUNT | | |
| 3.2 | FILTER | 3.2.1 | FLOW | | |
| | | 3.2.2 | DENSITY | | |
| 3.3 | IN/OUTPUTS | 3.3.1 | FREQ OUT | | |
| | | 3.3.2 | CTRL OUT | | |
| | | 3.3.3 | mA-OUT | | |



| Level 2 | | Level 3 | | Level 4 | |
|---------|-------------|---------|-------------|---------|------|
| No. | Name | No. | Name | No. | Name |
| 3.4 | DATA CONFIG | 3.3.4 | CTRL IN | | |
| | | 3.3.5 | CTRL IN 2 | | |
| | | 3.3.6 | mA-IN I1 | | |
| | | 3.3.7 | INTERFACE | | |
| | | 3.3.8 | FAULT MODE | | |
| | DATA CONFIG | 3.4.1 | SAVE DATA | | |
| | | 3.4.2 | RECALL DATA | | |
| 3.5 | RESET TOTAL | | | | |
| 3.6 | CLEAR LOGS | | | | |

Tab. 10: Menu items "SETUP"

7.5.4. Menu Item „I/O-TEST“

| Level 2 | | Level 3 | | Level 4 | |
|---------|----------|---------|------------|---------|------|
| No. | Name | No. | Name | No. | Name |
| 4.1 | FREQ OUT | | | | |
| 4.2 | CTRL OUT | | | | |
| 4.3 | mA-OUT | 4.3.1 | mA-OUT I1 | | |
| | | 4.3.2 | mA-OUT I2 | | |
| | | 4.3.3 | FAULT MODE | | |
| 4.4 | CTRL IN | | | | |

Tab. 11: Menu items "I/O-TEST"

7.5.5. Menu Item „SERVICE“

| Level 2 | | Level 3 | | Level 4 | |
|---------|--------------|---------|--------------|---------|-----------|
| No. | Name | No. | Name | No. | Name |
| 5.1 | CALIBRATION | 5.1.1 | METER VAR. | | |
| | | 5.1.2 | TEMP CALIB. | | |
| | | 5.1.3 | AIR CALIB. | 4.1.3.1 | AUTOMATIC |
| | | | | 4.1.3.2 | MANUAL |
| | | 5.1.4 | WATER CALIB. | 4.1.4.1 | AUTOMATIC |
| | | | | 4.1.4.2 | MANUAL |
| | | 5.1.5 | PCZ MODE | 4.1.5.1 | OFF |
| | | | | 4.1.5.2 | ON |
| 5.2 | ACCESS CODE | | | | |
| 5.3 | RECALL FACT. | | | | |

Tab. 12: Menu items "SERVICE"

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